Better Crops

WITH PLANT FOOD

November-December 1960

20 Cents

FORAGE FERTILIZATION PAYS

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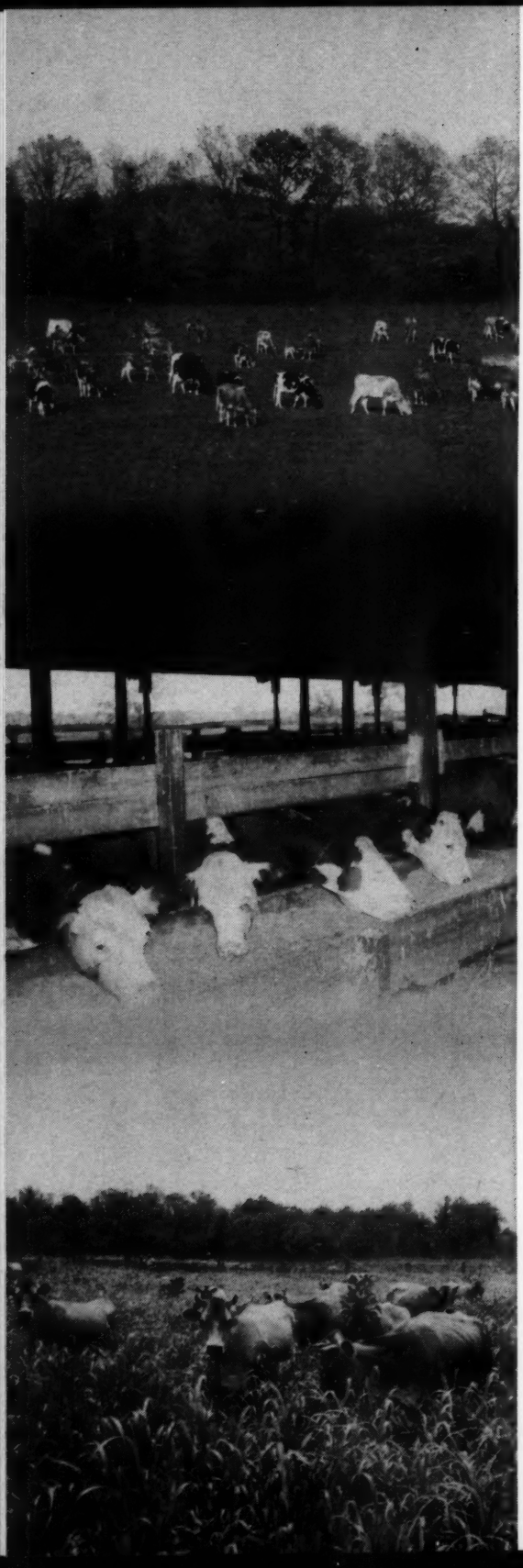
A Special Issue



An Introduction

NOT MANY businesses expect to operate for long at only 50% capacity.

How long can the business of forage farming—or grassland farming, if you prefer—continue to pay off at a production level of 50% or less capacity? Certainly not indefinitely with the squeeze of costs and prices becoming tighter all the time.

Farm profits depend on high yields per acre. Fixed costs for land, machinery, land preparation and others are high today, and they remain essentially the same whether high or low yields are produced. The need to lower unit production costs in order to maintain a profit margin has made it increasingly important for the farmer to produce more from each acre.

A PROFITO

More farmers should ask themselves this question:

"How many dollars do I spend to purchase hay or other feed that could be produced at lower cost on the same acres I now farm?"

High yielding, high quality homegrown forage is cheaper livestock feed than either purchased or home-grown grain.

To be sure, many farmers who have a sound forage program as the basis of their operation already are operating above 50% capacity, and sometime ago realized that they must do this to stay in the business. They also recognize that the amount of forage is not only important, but also the quality and efficient use of it by livestock. Such farmers, unfortunately, are not the majority.

Don't Miss the Opportunity

The fact that most farmers operate at the other end of the scale—50% or less of capacity—makes the

Top picture: Auburn University Agricultural Extension Service. Center and bottom pictures: Auburn University Agricultural Experiment Station.

profit opportunity for them unusually attractive. Good livestock management is often cancelled by poor management of the forage program. Maybe all that is needed to realize this profit potential is an adequate and balanced fertility program. Too little lime often will block all other roads to efficiency.

Possibly more productive forage species or better management of the grazing and cutting program are needed. Insects and diseases may be part of the problem. Commonly, two or more of these factors are responsible for low yields and costly production, and to take care of only one without regard to the others, can at best correct only part of the problem. In such cases more fertilizer alone will not do the job; neither will any other single thing. *All controllable limiting factors must be eliminated.*

OPPORTUNITY WORTH TAKING

Have you ever asked yourself:

"How many dollars do I spend to purchase hay or other feed that could be produced at lower cost on the same acres I now farm?"

By Robert E. Wagner

American Potash Institute

Most agricultural authorities agree that lack of fertility is one of the most common and damaging limiting factors to high and efficient production from forage in many parts of the country. Obviously, this would not be true in the dry range country of the West where lack of moisture is such an overpowering factor. In the drier parts of the range country, the native fertility of the soil is adequate to support all the production that the amount of available moisture will support. Under these conditions, fertilizer will not solve the problem.

Nevertheless, the possibilities for economically increasing production on the more favorably situated ranges should not be overlooked. Recent research in parts of the range country have shown that to ignore fertilizers is to settle for something less than maximum returns. For example, profitable responses to fertilizer applications have been obtained in the northern Great Plains and on the annual ranges of California.

The No. 1 Limiting Factor

On many of the quarter billion acres of grassland in the humid parts of the country—from the Great Plains east and in the Pacific Northwest—lack of fertility is the number one limiting factor. Research and farmer experience have convincingly shown that balanced fertility programs will not only raise per-acre yields and improve quality, but will bring about more efficient production as well.

One example of what the use of the right balance of nutrients can mean is provided by some Virginia work. In an 8-year study of alfalfa fertilization, the value of hay produced per acre—less fertilizer costs—averaged $96.42 annually from 800 pounds per acre of 0-12-6 compared to $120.66 from the same amount of 0-6-12. Simply by using the right ratio, from 50 acres of alfalfa this would mean $1,200 more return each

year: A handy down payment on a car or tractor . . . or just the thing to send the son or daughter to college.

Neglected Forage

Despite examples of this kind and many still more convincing that could be cited, a very small percentage of our forage acres—usually less than 10%—gets recommended fertilizer treatment.

A good example of how our grasslands still are largely neglected is provided by figures showing the percentage of forage acreage in the Northeast that is fertilized and the amount that these fertilized acres receive, keeping in mind that the Northeast is primarily a grassland region with more than three times as much acreage in forage as in corn and small grains combined.

In New York it is estimated that only 7% of the hay and pasture acreage receives fertilizer; in Pennsylvania, no more than 15% and in New Jersey, possibly as much as 31%. In contrast, approximately 90% of the corn acreage is fertilized today.

So, only these few acres of forage get any fertilizer at all. The vast majority receives none. On these few acres that are fertilized, New York uses an estimated average of 60 pounds per acre of P_2O_5 and 35 pounds of K_2O; Pennsylvania, 55 pounds of P_2O_5 and 55 pounds of K_2O; and New Jersey, 53 pounds of P_2O_5 and 46 pounds of K_2O.

College Recommendations Ignored

In most cases these usage rates are far below college recommendations, particularly as far as potash is concerned. Top recommendations now call for as much or more fertilizer for hay and pasture than for many other crops. For example, New Jersey and Virginia are now recommending as much as 1,000 pounds per acre of 0-9-27 fertilizer each year for alfalfa. These recommendations are soundly based on experience, research findings, and soil tests.

The familiar pattern of development in fertilizer recommendations has taken place in the Northeast. Of course, the need for lime has been long recognized, *although too often ignored.*

The early fertilizer recommendations (in addition to lime) for pastures and even for alfalfa called for phosphate only. Soon potash became critical. Then mixed fertilizers with phosphate and potash in a 2:1 ratio were recommended. It was not long before 1:1 ratios were needed, and today 1:2 and 1:3 ratios (such as 0-10-20 and 0-9-27) are commonly recommended for alfalfa.

In some states, straight muriate of potash is suggested for low potash soils.

These are college recommendations, *but unfortunately too few farmers follow them.*

The nitrogen story is also an interesting one. Its use on pasture or hay where it is difficult to maintain legumes increased sharply in recent years. Along with it has come a recognition of the need for adequate potash and phosphate to balance the high nitrogen rates. Again, it is a matter of balanced nutrition—the right amounts of nitrogen, phosphorus, and potassium and lime to maintain stands and high yields at minimum cost.

More Profit the Easy Way

To sum up, the use of more and better balanced fertilizers (along with other recommended production practices) to produce more forage will increase the livestock farmer's efficiency and make him more money. Why?

(1) Because feed makes up more than half the cost of producing most livestock, to substitute low cost, but high quality, forage for expensive grains and other concentrates is like buying at discount. Here is a real bargain producing the same amount of meat or milk for less money.

(2) Because much of today's forage is producing no more than half

of what it could (and should to maximize profits) if a balanced system of proper fertilization together with other improved practices were used.

(3) Because fertilizer is one of the best buys a farmer can make. In terms of plant food content fertilizer prices have advanced less than 10% since 1939, while farm labor costs have more than tripled and prices received for farm products today are about 260% higher than in 1939. Put it this way: if the $20 you invested in plant food in 1939 produced a crop increase worth $60, then today you would have to spend only $2 more for the same amount of plant food, but your crop increase would be worth over $150.

It has been said you pay for fertilizer whether you buy it or not. If you don't use it, you pay for it in reduced yields and lower quality.

Emphasize the Profits

How can we get more people to see and believe in this profit potential from properly fertilized forage? One way is to put greater emphasis on the profit angle in reporting results from fertilizing forage. Convert yields to profits. Yields alone fail to excite many people, but everyone is interested in profit.

In other words, show how proper forage fertilization pays. To show profits on a per-acre basis is helpful —*but better still, profit from a 50 or 100-acre unit.* Then it is large enough for the farmer to see that if he fertilizes at recommended rates rather than something less, the extra net income would buy him a tractor or a truck perhaps, or at least a down payment on one.

We need a "break-through in appreciation" of forage fertilization to go along with the facts!

THE END

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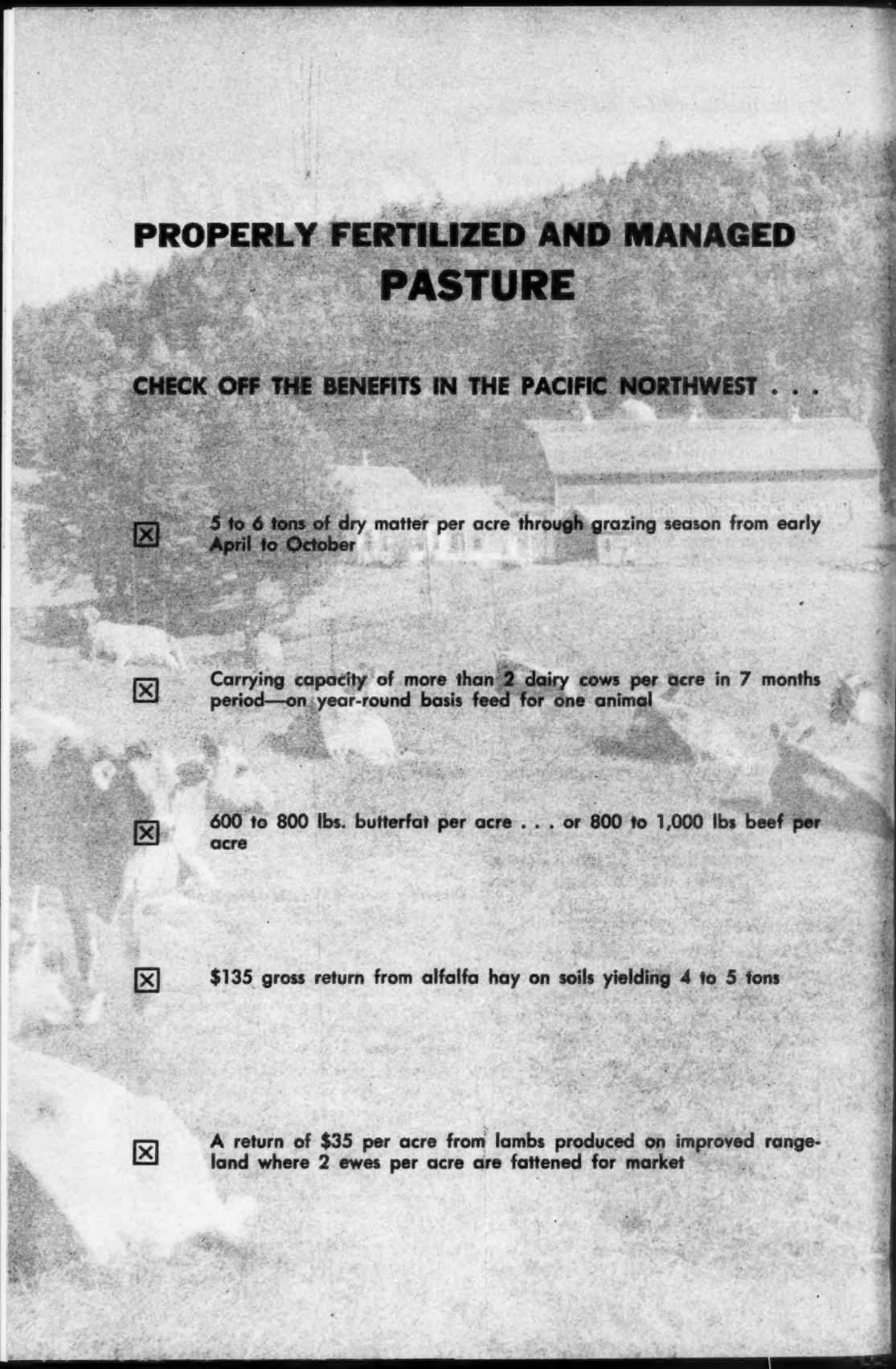
ON THE COVER . . .

. . . the forage farmer, like any businessman, must make a profit to stay in business. This means producing as much high quality milk and meat per acre as he can—as economically as he can. More and more farmers are finding that proper forage fertilization is a highly economical way to produce palatable, nutritious feed for their animals. Such economical production—caused simply by reduced unit production costs—means money in the farmer's pocket.

Cover picture by James Garvin
Visual Aids Specialist, Maine
Agricultural Extension Service



PROPERLY FERTILIZED AND MANAGED PASTURE

CHECK OFF THE BENEFITS IN THE PACIFIC NORTHWEST . . .

☒ 5 to 6 tons of dry matter per acre through grazing season from early April to October

☒ Carrying capacity of more than 2 dairy cows per acre in 7 months period—on year-round basis feed for one animal

☒ 600 to 800 lbs. butterfat per acre . . . or 800 to 1,000 lbs beef per acre

☒ $135 gross return from alfalfa hay on soils yielding 4 to 5 tons

☒ A return of $35 per acre from lambs produced on improved rangeland where 2 ewes per acre are fattened for market

In yields, 9,000 lbs of top quality hay on a non-irrigated soil 30 inches deep.

WITH LIME

In dollars, $135 per acre gross figuring alfalfa hay at $30 per ton.

In yields, about 1,000 lbs of weeds and poor quality forage.

WITHOUT LIME

In dollars, $15 gross per acre figuring alfalfa hay at $30 per ton.

Figure 1

MAKING FORAGE FERTILIZATION PROFITABLE IN THE NORTHWEST

By T. L. Jackson **Oregon State College**

THAT PART of the Northwest area lying west of the Cascade Mountains in Oregon and Washington, plus the northwestern corner of California, has a climate unique in the West.

Annual rainfall varies from 30 to more than 100 inches—most of it coming during the mild winter season. Summers are comparatively cool and dry. A good example is the Willamette Valley of Oregon.

Average rainfall is 40 inches a year, 62 percent during the four months of November through February. Less than 1 inch falls during the two summer months of July and August. Mild January temperatures average 39 degrees. Summer temperatures are cooler than most regions, averaging 67 degrees in July.

This combination of rainfall and temperature has developed the only significant area of acid soils west of the Rocky Mountains, in contrast to calcareous and alkaline soils throughout most of the West.

The degree of soil acidity varies. Many of the alluvial valley floor soils

With Potash

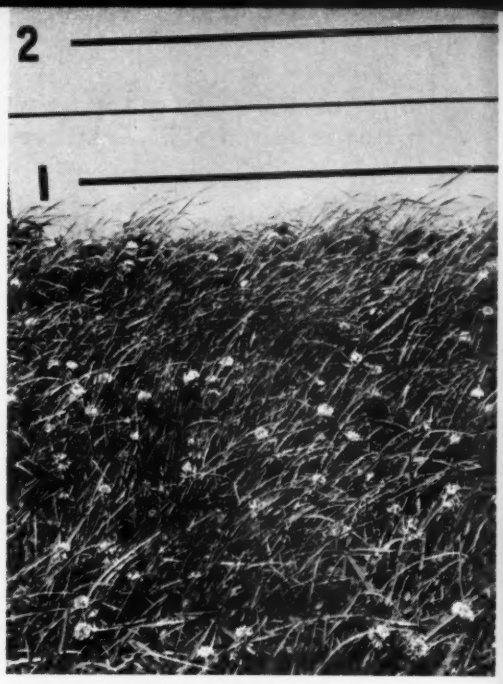


Figure 2—Potash is very importan

Above: Adequate Lime and Phosphate *Plus* split applications 200 lbs potash per acre each year

are moderately acid (pH 5.7 to 6.0) in the surface soil, with acidity decreasing in the subsoil. Most of the residual hill soils surrounding the valley floors are moderately to severely acid (pH 5.0 to 5.5) in the surface soil, with acidity increasing in the subsoil.

This combination of rainfall, acid soils, mild winters, and dry summers presents *soil fertility* and *forage management* problems not found in most other areas of the West.

Meeting Fertility Problems

Lime Needs

Soil acidity is one of the first things to determine when deciding the legumes to grow for forage production. Alfalfa, the highest yielding legume, requires fairly deep, well-drained soils and more lime than other legumes.

Figure 1 shows the lime response obtained on many hill soils in the Northwest. The plot in the foreground without lime yielded about 1000 pounds of weeds and poor quality forage. The limed plot in the background yielded 9000 pounds of good quality alfalfa hay on a non-irrigated soil 30 inches deep.

Ladino clover and New Zealand white clover are the main legumes grown in irrigated pastures and will grow under more acid conditions. Subterranean clover is an important legume on the hill soils and rangeland through this area where irrigation is not available. Less lime is needed to produce subclover and white clovers than to grow alfalfa successfully.

Phosphate Needs

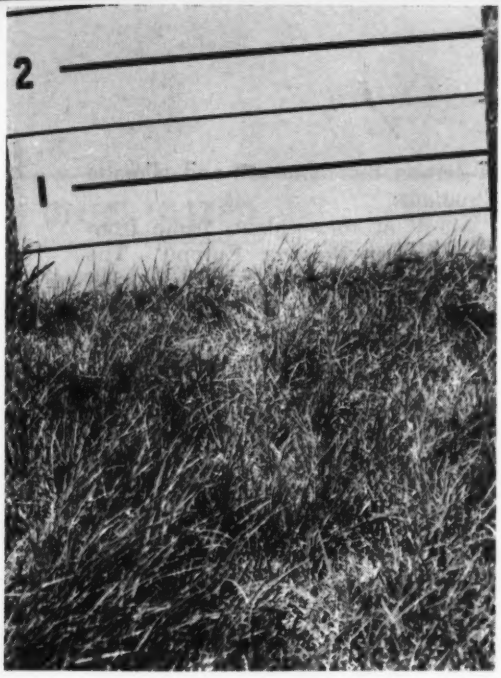
Many soils throughout this area are deficient in available phosphate for legume production. Annual applications of phosphate are important, especially for the hill soils and for many of the valley floor soils.

Phosphate is important in establishing legumes. It should be banded directly beneath the seed or in close proximity to the seed at planting time to insure seedling vigor. Figure 3 shows the difference between broadcast and band applications of phosphate on seedling vigor of alfalfa at the Red Soils Experiment Station.

Potash Needs

Potassium deficiency varies in different parts of this Northwest area. It depends on soil parent material and the kind of management and crop production practices the soils have undergone. Adequate potassium is necessary to maintain vigorous growing legumes in grass-legume pastures and to insure a successful alfalfa stand where grasses are planted with alfalfa or native grasses volunteer.

Figure 2 shows how important potash is in maintaining the stand of legumes. These plots are on the John Jacob Astor Experiment Station near the mouth of the Columbia River. The right plot had adequate lime and phosphate, the left plot same rates of



maintaining legumes in a pasture

Above: Adequate Lime and Phosphate

lime and phosphate plus split applications of 200 pounds potash per acre each year.

Comparatively mild winters encourage grass growth throughout the winter months. Winter growth of grass increases the problems of using nitrogen on grass-legume pastures and maintaining a vigorous stand of legumes in the mixture.

Adequate fertilization and good grazing management are essential to maintain legumes. Adequate fertilization means plenty of phosphorus, potassium, sulfur, and boron on soils having sufficient lime.

A very important management problem is the use of winter grass growth when the pastures are wet. Excessive accumulation of grass during the winter and early spring can crowd out the clover. Pastures are often cut to utilize part of the feed produced during the spring season.

Competition between grasses and legumes is more critical on soils low in potassium. Grasses tend to "steal" much of the potash from legumes.

No Potash

Sometimes it pays to apply split application of potash, a sufficient application in early spring and a summer application if irrigation permits.

Boron and Sulfur Needs

Boron and sulfur are deficient in many soils throughout the Northwest. Sulfur can be applied as a part of many fertilizer materials such as ammonium sulfate, single superphosphate, 16-20-0 ammonium phosphate and others. When sulfur is not added with the other fertilizer materials, many farmers add 150 to 200 lbs. of gypsum (calcium sulfate) per acre each year for legumes.

Boron deficiency on clover and alfalfa will show up on most soils that did not receive previous boron applications for another crop. Boron deficiency is most apparent where legumes are grown without irrigation. It is applied as a mixture with other fertilizers, as borated gypsum and as agricultural borax.

Meeting Management Problems

In general, pasture and hay production can be divided into three different management situations.

1 Irrigated pastures: Most dairy herds in this area depend on irrigated pastures for forage during the summer growing season that lasts about seven months. Pastures are irrigated on a wide variety of soil conditions. And the important legume is generally either Ladino or New Zealand white clover seeded with one or more grasses. Important grasses are orchardgrass, Alta fescue, ryegrass and meadow foxtail.

New Zealand white clover and ryegrasses are used more along the coast where summers are cooler and favor the growth of these species.

Ladino clover and orchardgrass or

CONTINUED ON PAGE 26

Figure 1—Vigorous growing mixture of ladino clover-orchardgrass

IN the section known roughly as the Upper South, over half the forage production comes from "cool season" perennial pasture plants. Further South, these plants are much less used although they are still quite important in certain favorable soil and climatic situations.

Many of these plants came from Northern or Western Europe. The climate of much of the Southern region is suitable for their growth, but most of the soils are not—that is, not in their natural state. So, when you decide to grow this kind of pasture, fertilization becomes essential.

Major Perennials

The major cool season perennials used in the region are Ladino clover, intermediate white clover, alfalfa, orchardgrass, tall fescue, and Kentucky bluegrass.

In the cooler parts of the Upper South, white clover-Kentucky bluegrass mixtures cover large acreages of the steeper, rougher uplands and are used as more or less permanent sods. These sods, when properly fertilized, are quite productive and nutritious in the spring but tend to fall off sharply in both growth and quality during hot weather.

Ladino clover-orchardgrass (Figure 1), Ladino-tall fescue, and alfalfa-orchardgrass mixtures are usually more

FERTILIZING COOL SEASON PERENNIAL F

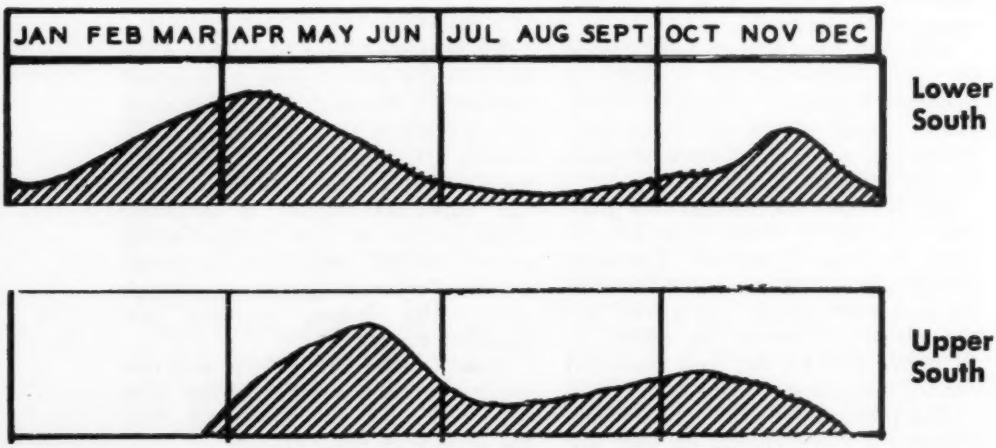
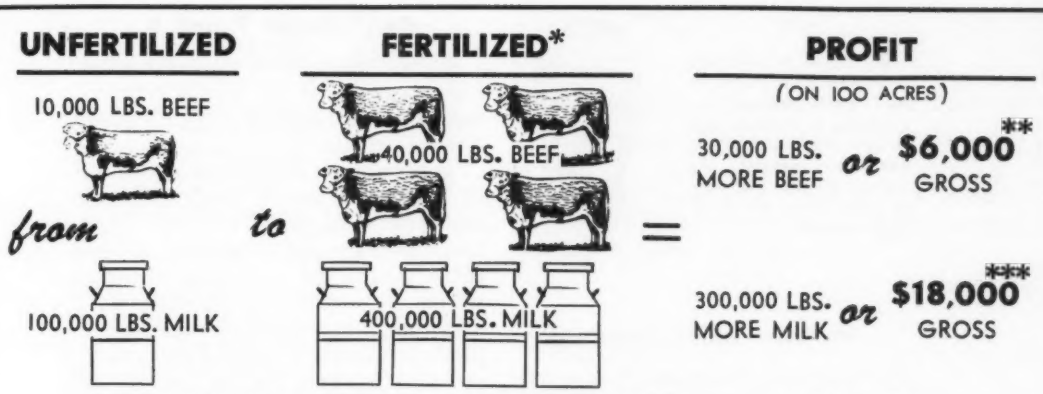


Figure 2—Seasonal distribution of forage production of ladino-tall fescue or ladino-orchardgrass mixtures



*Fertilized pasture calculated as furnishing about 20% more total digestible nutrients per ton dry forage than unfertilized pasture.

**Equivalent to 100 animals averaging 1,000 lbs. in weight over the grazing season, gaining 2 lbs. per day for 150 days—beef at 20¢ per pound.

***Maintenance and 20 lbs. milk per day from 100 cows for 150 days.

Figure 3—Calculated yield of beef and milk from 100 acres of unfertilized compared with 100 acres of fertilized improved pasture mixtures.

productive, afford a better seasonal distribution of forage, and can be utilized for silage and hay, as well as for grazing. Since these mixtures tend to decline in production after 5 or 6 years, they are usually confined to till-

AL PASTURES IN SOUTH

By
W. W. Woodhouse, Jr.
and
D. S. Chamblee

N. C.
State
College

able soils and rotated periodically with other crops.

Outside the bluegrass area, taller growing mixtures predominate in the Upper and Mid-South areas. Further South, orchardgrass drops out, intermediate white clover replaces Ladino, and in the Deep South intermediate white clover is widely used with such warm season grasses as Dallis and carpet.

In recent years, birdsfoot trefoil has shown promise as a long-lived perennial legume at elevations of above 2500 feet in a few counties in North Carolina, with promise under similar conditions in other states.

For a Balanced Program

Cool season pasture plants typically produce 60% or more of their total season's production by June 15 each year (see Figure 2). So, in order to have a balanced forage program, a silage cut should be made on at least a portion of white clover-grass, Ladino clover-grass, or alfalfa-grass pasture. In addition, summer growing warm weather plants are needed to fill the summer period.

As further noted in Figure 2, summer production from cool season perennials is less in the Lower South, but in turn, higher winter production is obtained during the milder winters.

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Southern Soil Demands

Fertilization principles for cool season pasture plants in this region are the same as in the other humid areas of the United States. However, soil and climatic conditions in the South accentuate certain factors.

The highly weathered soils are generally acid and likely low in calcium, nitrogen, and potassium. In most cases, native phosphorus supply is very low and the soil's tendency to fix this element often high. This means growing legumes such as the white clovers and alfalfa usually requires liberal amounts of phosphate, potash, and lime. The soil itself provides little nitrogen for the grasses, demanding large amounts of this nutrient through (1) a vigorous growing legume, (2) a fertilizer directly applied, (3) or manures.

Even more important, Southern soils generally have a limited capacity for storage of nutrients. So, regular maintenance fertilization is very important in keeping such pastures producing year after year. Since cool season plants (both legumes and grasses) demand more phosphate and potash than warm season plants, cool season pastures can suffer quickly from inadequate P and K maintenance fertilization.

Fertilization requirements for cool season pastures in the region vary widely among different soil situations. Because they are more productive, tall growing, rotation type mixtures usually respond to more liberal fertilization than bluegrass sods.

Don't Forget P and K

A good example for the taller growing mixtures is a Ladino clover-orchardgrass mixture in Piedmont North Carolina:

The soil should be limed to a pH of between 6 and 7, preferably several months ahead of seeding. Then, under average soil conditions, around 600-800 lbs. of a 2-12-12 mixture would be applied at planting time. This mixture would be expected to produce around 3 tons of dry matter per acre per year for the next several years. To maintain this production, an annual topdressing of 400 to 600 lbs. of an 0-10-20 or 0-9-27 mixture would be required.

With less demanding bluegrass-white clover mixture, the rate would be reduced by ⅓ to ½ and shifted toward a 1-1 ratio of phosphate and potash. Under very extensive management, lime and phosphate might be applied and the topdressing of phosphate done at 2 to 3-year intervals.

Pure grass sods of cool season perennials require from 50 to 100 lbs. N in early spring and again in the fall. And they also require P and K. Cool season grasses (such as orchard and tall fescue) grown with adequate nitrogen will remove about the same amounts of potash and phosphate as the productive legume-grass mixtures. Since these grasses tend to be more effective in extracting these nutrients, their P-K topdressing requirements are probably a little less than those of the mixtures—30 to 40 lbs. of P_2O_5 and 60 to 120 lbs. of K_2O per year.

Does it "Pay" to Fertilize?

People often ask, "I know I have to fertilize to grow these pastures, but will it pay?" A couple of examples help answer this question:

First—A ladino clover-grass mixture in North Carolina.

Evidence over the last 15 years indicates it takes about $15 worth of fertilizer and lime per acre per year

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to keep this kind of mixture producing properly. The increase, due to fertilizer, is about 2 tons of dry forage per acre—*over three times the production without lime and fertilizer.*

Suppose we had *100 acres* of this type pasture. Comparisons between the production expected from 100 acres of unfertilized and fertilized improved pasture mixtures of Ladino-grass are presented in Figure 3.

One hundred acres of this type of fertilized pasture would give us 200 tons of *extra* forage at a fertilizer cost of $15.00 an acre or $7.50 per ton. This *extra* forage, properly utilized, would produce about 30,000 lbs. of beef worth *$6,000 gross* or about 300,000 lbs. of milk worth $18,000 gross. (See Figure 3.)

Second—A bluegrass-white clover mixture in North Carolina.

Let's look at bluegrass-white clover with minimum lime and fertilizer in Western North Carolina—1 ton lime every 10 years, 25 lbs. P_2O_5 and K_2O annually.

Cash fertilizer cost of increased production is about $5.00 per ton. The increase is around ¾ ton per acre—a little more than the total without fertilizer. There are about a half million acres of this type pasture in the 17 mountain counties of North Carolina. Thus, annual increase from fertilization of these pastures would be about 375,000 tons. Properly utilized, this could produce over 51,000,000 pounds of beef with a gross value of over $10 million, at a fertilizer cost of less than $2 million. This is for the area of this kind of pasture in North Carolina alone. Adjoining states contain large areas of similar sods. **THE END**

CHECK YOURSELF

Yes____ No____

Some questions to determine how much this article interested and informed you.

1 Cool season pasture plants produce 60% or more of their total season's production by June 15 each year.

yes____; no____

2 Southern soils generally have a limited capacity for storage of nutrients.

yes____; no____

3 The bluegrass sods respond to more liberal fertilization than the tall growing, rotation-type mixtures—such as ladino clover-orchardgrass, ladino-tall fescue, alfalfa-orchardgrass.

yes____; no____

4 Cool season pastures can suffer quickly from inadequate phosphate and potash maintenance fertilization.

yes____; no____

5 The highly weathered soils in the South are generally acid and likely low in calcium, nitrogen, and potash.

yes____; no____

6 Cool season grasses (such as orchard and tall fescue) grown with adequate nitrogen remove very little potash and phosphate.

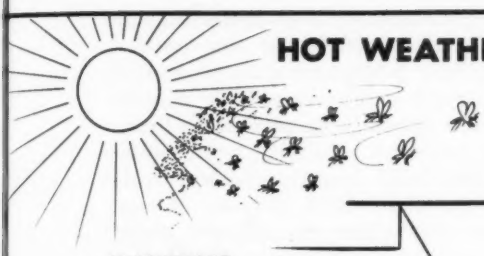
yes____; no____

7 It takes only about $15 worth of fertilizer and lime per acre per year to keep a ladino clover grass mixture producing properly—that is, 3 *times* the production *without* lime and fertilizer.

yes____; no____

8 Profit from cool season perennial pastures in the South depends strongly on proper use of lime and fertilizer on them.

yes____; no____



HOT WEATHER AND FLIES CANNOT HOLD BACK THIS PASTURE MANAGEMENT

		GAIN OF BEEF PER ACRE	GAIN PER ANIMAL PER DAY	DRY WEIGHT FORAGE YIELD PER ACRE
BLUEGRASS–ORCHARDGRASS 10 steers on 13.8 acres of old sod	**500 LBS. 5-10-10 PER ACRE**	**17.4** POUNDS	**0.09** POUNDS	**556** POUNDS
SUDANGRASS–SOYBEANS 10 yearling steers on 9.2 acres sown May 21		**56.5** POUNDS	**1.13** POUNDS	**1,896** POUNDS

Figure 1.- Yield of forage and beef per acre from July 10 to August 21, at New Brunswick, N. J.

ANNUAL PASTURES

By Milton A. Sprague

New Jersey Agricultural Experiment Station

ANNUAL crops are among the most important pasture crops on the farm and are increasing in importance each year as farming becomes more intensive.

Their greatest advantages include:

1 Ease of culture,

2 Confidence of high yields and uniform quality,

3 Versatility in seasonal production, soil adaptation and capacity to fit into a rotation.

Small grains in fall and in spring frequently double the length of the grazing season in the Northeast.

Although land preparation and seed costs are greater with annuals over a period of years than with perennial crops, these costs are more than offset by greater total return per acre in many instances.

A succession of two or three crops a year on the same ground in New Jersey meant as much as 60% more yield than the best of perennials. Add to this the convenience of off-season production and multiple use for hay, silage, or soiling and the farmer can count many immediate returns.

Annual pastures for the most part consist of sudangrass or millet during mid-summer and one of the winter cereal grains for grazing in late fall, winter, or spring. In this capacity they are used most often to supple-

Dr. M. A. Sprague is Chairman of the Farm Crops Department at Rutgers State University at New Brunswick, New Jersey. He is widely known in the field of forage research.

ment perennial pastures during low production periods.

A succession of annuals are grown on some farms. They include winter and spring grains, vetch, field peas, sudangrass, millet, soybeans, rape, and kale to provide almost a continuous supply of pasturage throughout the year.

On other farms, rye, wheat, or oats supplement perennial pastures for 2 months in fall and again in spring, frequently doubling the length of the grazing season.

High Fertilizer Needs

Annuals are easy to plant, grow fast from seed, and respond quickly to heavy fertilizer applications. The newer varieties of sudangrass (such as Piper) have the advantages of low prussic acid content which permits safer usage. Better varieties of small grains bred and selected for forage production give higher yields of protein-rich feed.

But it must be remembered that the higher the yield potential of the new varieties the greater their mineral nutrient requirements. This means higher fertilizer usage to get full growth potential.

Sudangrass, millet, and most cereals respond readily to as much as 1,000 pounds of 10-10-10 fertilizer or the equivalent. It is commonplace now to topdress the annual grass crops with additional amounts of nitrogen fertilizer between grazings.

In Georgia, rye, oats and ryegrass each responded to each increment of nitrogen fertilizer up to 400 pounds N per acre. These same trials indicated phosphorus and potassium are also needed for balanced nutrition.

In New Jersey, rye sown alone and with winter vetch received 500 pounds 5-10-10 fertilizer at planting. From this treatment, the rye sown alone yielded 2,491 pounds, the rye with winter vetch 4,294 pounds of dry matter per acre from fall and spring grazings plus aftermath growth for silage.

When 40 pounds of nitrogen was used per acre in November, after fall grazing, total yields amounted to 4,519 pounds of rye and 5,461 pounds of rye plus vetch.

And when 40 pounds of nitrogen fertilizer were added in late February, before grazing in spring, yields totaled 6,300 pounds (rye) and 6,241 pounds (rye plus vetch) dry matter per acre.

Vetch contributed much to the total forage yield in these trials—but only during late spring in May and where insufficient nitrogen fertilizer was used. Rye produced well in both fall and spring but required adequate fertilizer to make this growth.

Spring applications of nitrogen were more effective than late fall applications on this soil. The more than 6000 pounds dry matter obtained is about equal to a full season's production of well fertilized perennial grass-legume pasture on these soils.

Good Summer Gains

Some years ago, poor mid-summer gains on pasture were blamed on hot weather and flies. A New Jersey trial put one lot of 10 steers on 13.8 acres (3 pastures) of an old orchardgrass-bluegrass sod fertilized in spring with 500 pounds 5-10-10. Another lot of 10 yearling steers were put on 9.2 acres (2 pastures) of sudangrass-soybeans sown May 21 with the same fertility. Both were grazed from July 10 to August 21.

Results obtained reassured many of us that good gains of more than one pound of beef per day can be ob-

tained through the summer months on pasture alone *when adequate amounts of good forage are available.* (Figure 1).

In considering feed crops, some consideration should be given to the best method of cropping to obtain the greatest return of nutrients per acre. Grazing studies on fertile soils with winter small grains have shown about double the return of T.D.N. from grazing wheat or rye in fall and spring than from a single harvest as grain.

Many annual crops are now fed green as soiling crops, generally harvested at a stage similar to that suitable for silage. When three varieties of spring oats for silage and grain were recently compared, oats harvested for silage yielded nearly three times as much T.D.N. and two times the protein as oats harvested for grain.

It is logical that this difference could be extended through the use of higher rates of fertility. In these trials, forage harvests were during May, leaving ample time for a second forage crop during the season.

Certain of the annual grasses including ryegrass (Lolium) and rescuegrass (Bromus) are used extensively for winter grazing throughout the South. Crimson, bur and hop clovers have for many years contributed greatly, as has lespedeza, to pasture needs in the milder climates.

As land becomes more scarce and the need for forage yield per acre becomes greater, annual pasture and forage crops are likely to constitute a growing percentage of the forage in the diet of our livestock. **THE END**

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Yes____ No____

Some questions to determine how much this article interested and informed you.

1 The greater costs of land preparation and seed with annuals (compared to perennial crops) are more than offset by greater total return per acre in many cases.

yes____; no____

2 The higher the yield potential of the new varieties the greater their mineral nutrient requirements to get full growth potential.

yes____; no____

3 Fertility tests have shown that phosphate and potash were not needed on rye, oats and ryegrass when plenty of nitrogen was used.

yes____; no____

4 Sudangrass, millet, and most cereals respond readily to as much as 1,000 lbs. of 10-10-10 fertilizer or its equivalent.

yes____; no____

5 Poor mid-summer gains on pasture are due to hot weather and flies.

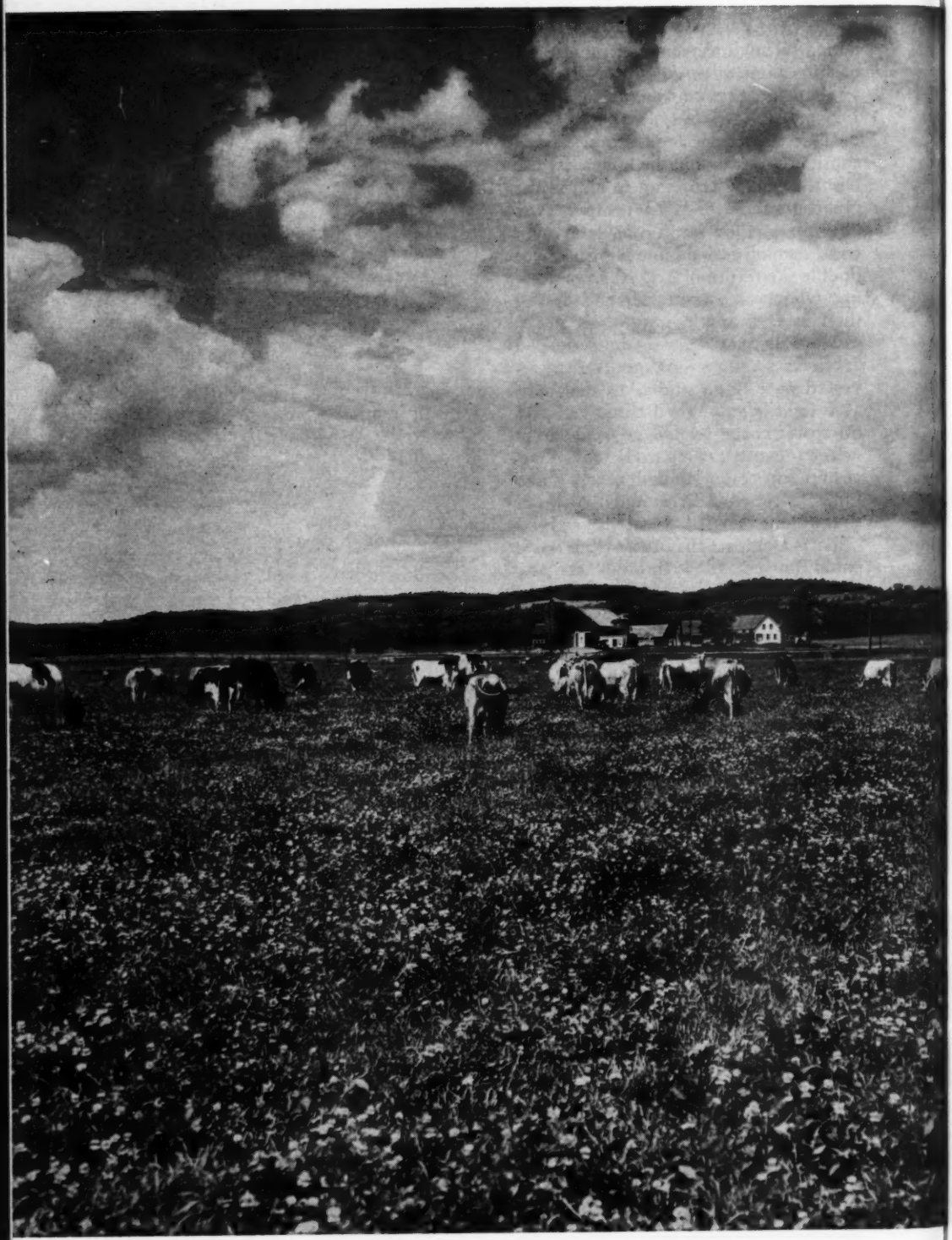
yes____; no____

6 In considering feed crop, the method of cropping has much to do with the return of nutrients per acre.

yes____; no____

7 Good gains of more than 1 lb. of beef per day can be obtained through the summer months on pasture alone when adequate amounts of good forage are available.

yes____; no____



INCREASE PROFITS BY FERTILIZING ROTATION PASTURES IN THE NORTH

By
Cecil S. Brown
University of Maine

Well-Fertilized Pastures

A Low-Cost Feed

THE DREAM of northern dairymen is green pasture herbage in unlimited supply from May to October. Northeast studies have shown that production costs of feed from grazed rotation pastures are often less than two-thirds the costs of grass silage or hay.

The fertilized rotation pasture is the heart of an economic pasture program on northern dairy farms. And liberal fertilization is vital to economic use of rotation pastures.

Establishment and persistence of productive pasture species are largely determined by soil fertility level. Inadequate fertilization results in weak, weedy seedings which soon revert to "native" sod. Labor and machinery costs of the original seeding are then difficult to justify.

Few dairymen yet recognize the potential value of fertilized rotation pastures. In many northern areas, *less than ten percent* of the rotation pastures receive topdressed fertilizer, even though practically *all* of the silage corn acreage is regularly fertilized. Apparently the dollar value of productive rotation pastures is still not recognized on many farms today.

Dollar Value Yet to be Recognized by many.

What Is It Worth?

Dairymen whose cows are grazing lush Ladino-orchardgrass, or green feeding productive alfalfa-brome, have little question about the dollar value of well fertilized pastures. A comparison of the milk check and grain bill tells the story. But what about the many farmers who still do not realize that fertilized rotation pasture can be the most profitable acreage on the farm?

The value of good pasture can be measured in terms of the hay and grain it may replace, as in a Delaware experiment conducted for five consecutive pasture seasons. One group of dairy cattle was rotationally grazed on fertilized Ladino-orchardgrass all season.

These central Maine cows have a productive August pasture because ladino clover has been maintained by years of timely grazing, overseeding, and annual fertilization.

A second group received no pasture, but was liberally fed hay, corn silage, and grain. Each cow of the barn-fed group received the following average amounts of feed during each season: 1450 lbs. 16% dairy ration, 1560 lbs. mixed hay, 4600 lbs. corn silage. In spite of this liberal feeding, the barn-fed group produced only 3% more milk than the cows maintained on pasture only.

The Ladino-orchardgrass pasture in the Delaware experiment was valued at $115 per acre. This was calculated from the costs of grain and harvested forage actually fed to the barn-fed cows. Table 1 tells the story.

Table 1. Acre Value of Ladino-Orchardgrass pasture. (Delaware)

Milk Production per acre: 4580 lbs.			
Feed required to replace pasture	Purchased grain	1940 lbs. =	$ 73
	Hay	2090 lbs. =	21
	Corn silage	6160 lbs. =	21
Value of each acre of pasture			$115

Good pasture worth $115 per acre in grain, hay, and corn silage it replaces.

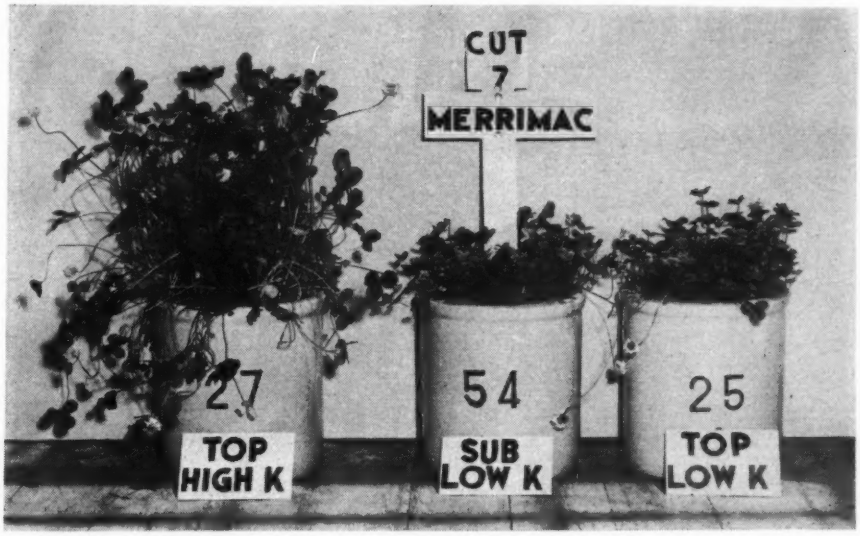
Legume Pastures Important

Legumes are highly prized in dairy cattle pastures—(1) because of their nitrogen economy, (2) because of their mid-summer productivity, (3) because of their superior palatability and intake by the grazing herd.

Nitrogen fixation by pasture legumes is still an important economic factor, despite the development of cheaper forms of fertilizer nitrogen. Productive pastures require more than 200 lbs. of available nitrogen per acre annually. Most soils of the northern regions supply only a small portion of this. In Maine tests, not more than 20 to 40 lbs. of N has been released annually by soils to unfertilized grass sods.

Nitrogen returned to pasture sods in the excreta of grazing animals is surprisingly inefficient in pasture production. While pure grass pastures often require 150 to 200 pounds of fertilizer nitrogen for intensive production, legume pastures require little or no nitrogen, saving $20 or more per acre in topdressing costs. Annual nitrogen fixation by good stands of legumes in Maine has ranged from 100 to 150 lbs. per acre by Ladino clover, to 200 to 250 lbs. by alfalfa.

Legumes in grazed dairy pastures influence the daily intake. Ladino clover and trefoil, for example, are highly palatable pasture species. In mixture with grasses they stimulate greater daily intake of pasture than pure grasses alone. In a three year grazing experiment at Washington State College, 30 to 50% Ladino clover in mixture with orchardgrass



Fixation and slow release can hold down your profits, if you don't use enough potash. Some soils tend to lock up much applied potash and release their own reserve potash so slowly that your pasture crop suffers. This greenhouse study of Maine soils is a good example. This 7th cutting of ladino shows how the topsoil and subsoil samples of Merrimac sandy loam were unable to supply appreciable amounts of reserve soil potash throughout the 9-months study. The study showed: (1) Total potassium up-take by 7 cuttings of ladino was only 126 lbs. K per acre following the use of 83 lbs. K at seeding . . . (2) Release of reserve potash was only 3 lbs. K per acre . . . (3) Potash hunger appeared in third cutting . . . (4) Little growth occurred between 5th and 7th cuttings . . . (5) All in contrast to high K check pot at left.

(Figure 1)

resulted in a *9% increase in daily milk per cow* over pure orchardgrass.

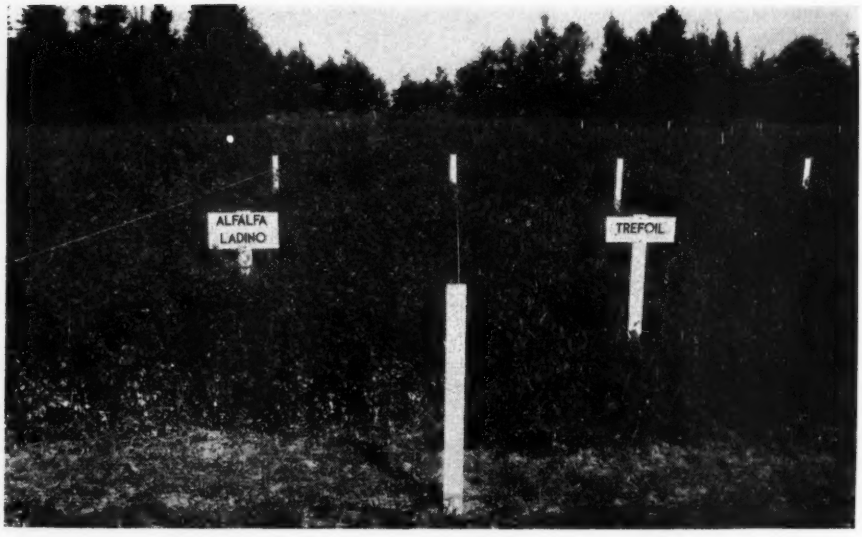
The main advantage of the Ladino pasture was its acceptance by the grazing herd, not higher acre yields. In fact, the nitrogen-fertilized orchardgrass produced 14% more forage per acre than the Ladino-orchardgrass, *but was inferior in daily milk production.*

Highly palatable legumes in mixture with pure grass increase milk production over grass alone.

More Fertilizer Needed in Seeding Year

Considerable progress has been made in recent years to reduce the risk of forage seeding failures. Farmers are selecting superior varieties, preparing better seedbeds, and using improved management practices to control competition of weeds and companion crops.

Considering the interest in better seedings, it is surprising that increased rates of lime and fertilizer for new seedings have not been more widely adopted. Forage seedings on many northern farms still receive only token applications of lime and commercial fertilizer.



2,690 lbs. per acre of Narragansett alfalfa

1,860 lbs. per acre of Mansfield trefoil

There are dollars in those pounds. These yields are equal to 60 to 80 cow-days of grazing. They were obtained in spite of a severe drought throughout late July and August. This is an example of forage production from well fertilized rotation pasture species in the seeding year. These plots were seeded in May and clipped off in early July. The yields shown above represent dry matter yield in the recovery growth in August.

(Figure 2)

Experimental results and farm observations have convinced us that *inadequate use of fertilizer and lime is the major cause of legume seeding failures in Maine.* Liberal use of plant nutrients has caused surprising tolerance to drought and weed or companion crop competition.

Inadequate fertilizer and lime usage causing legume seeding failures.

In one of our experiments, alfalfa seeded in mid-July was severely weakened by sudangrass sown at 40 lbs. per acre. The heavily shaded alfalfa yielded only .03 ton dry matter per acre in late August, compared to 0.9 ton for alfalfa sown without sudan. A 500 lb. application of 0-15-30 fertilizer in early September caused the weakened alfalfa to recover sufficiently for winter survival. In 1960, alfalfa recovery on the former sudan plots was nearly complete by the second cutting with yields 80% of those of the alfalfa check plots.

The critical importance of lime and phosphorus to rapid early development of legume seedings is well known. In recent years, we have become increasingly concerned also with potash requirements in the seeding year. Greenhouse experiments indicate that fixation of applied potash and slow release

Potash key fertilizer element in legume persistence.

of reserve soil potassium are serious problems on many of our soils. (Figure 1) In dry seasons, we have found that 100 lbs. K_2O per acre at seeding is not adequate on soils testing low in available potash.

"Insurance" Applications of Potash

We have been especially concerned about the potash nutrition of legume seedings following removal of a heavy companion crop for forage in midsummer. *No subsequent topdressing will pay richer dividends than an "insurance" application of muriate of potash or 0-15-30 in August of the seeding year. In many cases $5 worth of potash applied at this time may mean the difference between legume success and legume failure. The cost is relatively small when compared to initial seeding costs of $40 or more per acre.*

The pasture potential of *well-fertilized* seedings should be more widely recognized. Few dairymen realize that the recovery growth of vigorous legume seedings may produce over 60 cowdays of grazing in late summer of the seeding year. (Figure 2) Animal production from this forage alone often exceeds the increased costs of more liberal fertilizer usage for forage seedings.

Annual Topdressing Essential

Ideal rotation pasture: mixture of legumes and grasses in equal proportions

Rotation pastures require fertilization each year to prolong the life of desirable species and maintain their productivity. For maximum economy, adjust your fertilizer selection to meet the cyclic changes in botanical composition that normally occur.

During the early, high-legume years, fertilizer nitrogen is rarely required for intensive pasture production. A little nitrogen may be used on pastures unusually high in Ladino clover or alfalfa to stimulate grasses and reduce bloat possibilities. Requirements for topdressed phosphorus are also relatively low, if adequate fertilization has been practiced in the seeding year, because of the small annual crop removal of P.

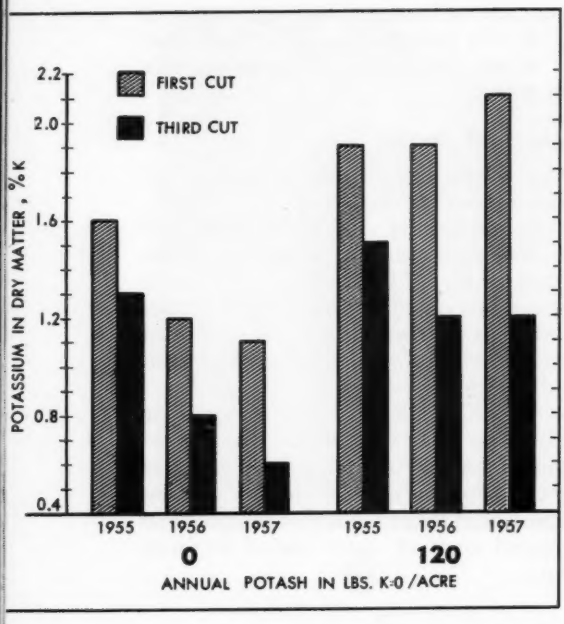
Available Potash Depleted

Numerous experiments throughout northern U. S. and Canada have shown that potassium is the key fertilizer element in legume persistence. Annual application of a high-potash fertilizer is usually necessary, since the reserves of available potassium in most dairy farm soils are depleted during the first year of cropping and rotational grazing.

Unfertilized pastures commonly dip into a period of potash starvation in mid or late summer even on soils with moderately high levels of reserve potassium. Drought intensifies the problem by further reducing the rate of release of reserve soil potash in summer.

Intensive nitrogen usage increases potash needs of pure grass pastures.

Look at the way potash content of Maine forages declined without fertilization in Figure 3. Ladino-timothy was seeded



Potash is like money—to make some you must use some.

Here potash content of ladino-timothy declined severely in the 3rd cuts when fertilizer K was not added after the seeding year. Even spring application of 120 lbs. K failed to maintain third cuts above a minimum level of about 1.5% K. When 240 lbs. K (not shown) was used annually, potash levels held at 2.0% or above for good legume persistence.

(Figure 3)

Dr. Cecil S. Brown New Hampshire native, conducts extensive teaching and research in forage management at the University of Maine. He earned his B.S. from New Hampshire, his M.S. and Ph.D. from Cornell.

in 1954 on Buxton silt loam, using a total of 150 lbs. K_2O in two split applications. Potash content was adequate in the first cutting in 1955, but approached deficiency in the third cut. Potash levels were critically low in the aftermath in 1956 and 1957, with yields declining to one ton per acre in 1957 (Table 2). Application of 120 lbs. K_2O each spring maintained a healthy potash level in the first cuts, but couldn't prevent deficiency levels in late summer.

Table 2—Effect of Potash Rate on Ladino-Timothy (Maine)

Annual K_2O	Potash Removal 1955	1956	1957	Yield 1955	1956	1957	% Ladino 3rd cut 1957
lbs./acre	K_2O—lbs./acre			D.M.—tons/acre			
0	128	61	24	3.5	2.2	1.0	21
120	145	137	109	3.4	3.1	2.5	60
240	166	182	149	3.7	3.2	2.8	82

A mixture of legumes and grasses in equal proportions is

Did you know:

$

That production costs from grazed rotation pastures are often less than two-thirds the costs of grass silage or hay.

$
That liberal plant food usage has caused surprising tolerance to drought and weeds or companion crop competition.

often considered the ideal goal in rotation pastures—compromising nitrogen economy, animal acceptability, and bloat control. Careful management is required to maintain its productivity, however. The grass component will require nitrogen fertilization for midsummer production. Timely grazing and liberal potash fertilization enable the legume to survive the increased grass competition. *Research has shown that vigorous grasses absorb soil potassium more readily than associated legumes under low potash conditions, causing potash starvation of the legume.*

Fertilized Grass Pastures Productive, Too

$
That the reserves of available potash in most dairy farm soils are depleted during the first year of cropping.

As legumes decline from rotation pastures, fertilizer practices must be changed to capitalize on the grasses that remain. While nitrogen fertilization must be sharply increased, phosphate and potash should be maintained *just slightly below the level recommended for legumes.*

Results from fertilized grass pastures are illustrated by grazing trials on Minnesota dairy farms in 1957 and 1958. Annual fertilization in ten farm demonstrations averaged approximately 150 lbs. N, 30 lbs. P_2O_5, and 60 lbs. K_2O—costing a little under $30 per acre. The increased milk production is shown in Table 3.

Table 3—Milk Production of Fertilized Grass Pastures (Minnesota)

	1957		1958	
	Unfert.	Fertilized	Unfert.	Fertilized
Acres per cow	2.0	0.8	1.5	0.8
Milk per acre (lbs.)	2320	5890	2910	5450

$
That no subsequent topdressing will pay richer dividends than an "insurance" application of muriate of potash or 0-15-30 in August of the legume seeding year.

Mineral demands of grass pastures increase with each successive year of intensive nitrogen treatment. In a New York experiment on Collamer silty clay loam, orchardgrass receiving 200 lbs. N annually showed little response to applied potash fertilizer the first year. By the second and third years, 100 lbs. K_2O per acre was adequate. And in the fourth season, 200 lbs. K_2O brought additional response.

Limited Acreage Necessary

$
That profits from 20 acres of well-fertilized, vigorous legumes are greater than from 40 acres of short-lived, half-starved legumes.

A limited acreage of highly productive legumes should be the first goal in pasture improvement. Increased investments in lime and fertilizer should not be spread over too many acres at first. *The profits from 20 acres of well-fertilized, vigorous legumes are greater than from 40 acres of short-lived, half-starved legumes.* A somewhat more extensive approach can

be taken in fertilizing grass pastures where species survival depends less on soil fertility level.

A good example of intensive legume pasture production is the case of Alton Benson, a progressive dairyman near Portland, Maine. Some years ago he decided to begin a green chop program for his 45-cow milking herd. First, he selected 30 acres of deep, well-drained soils with sufficient natural slope to reduce the hazard of winter ice sheet damage. Next, he invested several tons of lime per acre and liberal amounts of phosphorus and potash fertilizer, before seeding to an alfalfa-Ladino-brome mixture. After the seeding year, he has used liberal annual applications of high potash fertilizer to maintain excellent alfalfa stands for seven years, harvesting three times per season. Annual fertilizer costs have been about $600 for the 30 acres, using 7 tons of 0-15-30 after the first cut and 2 tons of muriate of potash after the second cut. The only nitrogen supplied has been in cow manure applied each fall.

Does It Pay?

Does it pay to treat a limited acreage of legumes this intensively? Mr. Benson thinks so. His milk checks for three summers have ranged *from $100 to $120 per day.* Alfalfa green chop twice a day has supplied the major part of his herd's feed requirements, supplemented with several bales of hay and several hundred pounds of grain.

The most profitable level of rotation pasture fertilization will, of course, vary greatly from farm to farm depending on alternative sources of feed, market price for milk, and other factors. But there is little doubt that most dairy farmers of the North could increase profits substantially through the use of more fertilizer on rotation pastures. **THE END**

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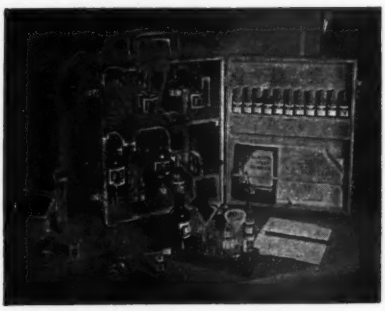

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PACIFIC NORTHWEST—CONTINUED FROM PAGE 7

Figure 3—Banding phosphate is important in establishing legumes. The plot on the left had phosphate banded 1" below the seed at planting time. The plot on right received phosphate broadcast.

Ladino clover and Alta fescue make up most of the pastures in such areas as the Willamette and Chehalis Valleys where summer temperatures are higher. Meadow foxtail and Alta fescue will produce better under conditions of poor drainage.

Forage production on well managed and fertilized irrigated pastures often reaches 5 to 6 tons of dry matter per acre distributed throughout the grazing season, from early April to October.

A carrying capacity of more than two dairy cows per acre is realized by many dairymen. Thus each acre of improved pasture is producing the feed for at least 1 animal on a year around basis. Yields of 800 pounds per acre of butterfat have been obtained and many good dairymen realize 600 lbs. of butterfat from well managed pastures. One acre of unimproved pasture that is not fertilized will seldom produce the forage for one cow during the summer months.

More and more irrigated pastures are being used for producing beef cattle in the Northwest. Steers are being grazed on some pastures during the summer months. In fact, 800 to 1000 lbs. of beef per acre have been produced on well fertilized and managed pastures during a summer.

Some farmers are using irrigated pastures for cow-calf operations. The forage for a cow and a calf can be supplied by each acre of well managed pasture. Silage and hay can be saved during the spring and summer to carry the cow through the winter.

2 Alfalfa production: Alfalfa is the highest producing forage crop that can be grown throughout the interior valleys on well-drained and limed soils. April and May rains make it necessary to use the first cutting as silage or green chop. Curing a hay crop is seldom possible when the first cutting is ready for harvest by May 10th.

The price of good quality alfalfa hay averages about $30/ton west of the Cascades.

Abundant alfalfa production depends on soil conditions and the availability of irrigated water to increase production during July and August. Four- to five-ton yields per acre are common on well-drained hill soils of three feet depth that have been limed and fertilized with phosphate, potash, sulfur, and boron.

Gross return from the properly limed and fertilized plot in figure 1 would be $135.00 per acre figuring alfalfa hay at $30/ton. This would be in contrast to a gross of $15.00 per acre from the plot in the foreground that has not been limed.

Alfalfa on deeper valley floor soils has yielded six to seven tons per acre with normal June rains. The alfalfa has extracted the soil moisture to a depth of seven or eight feet under nonirrigated conditions in the valley floor soils where the subsoils are not acid. Yields of eight tons per acre have been measured with irrigated alfalfa where the first cutting has been taken off as silage during early May. A yield of 7 tons per acre would mean a gross return of $210 per acre with alfalfa hay selling for $30 per ton.

3 Rangelands and hill soils: Pastures on many of the shallower hill soils and rangelands throughout this area are generally used for producing beef cattle and sheep.

Subterranean clover pastures are very well suited to these areas. Subclover is an annual plant that comes from seed each year when the fall rains start. The mild rainy weather causes these pastures to produce considerable forage during the winter months. The subclover pastures normally dry up when the clover plants mature and die in late June.

Dr. T. L. Jackson, Associate Soil Scientist and Extension Soils Specialist, is Project Leader for soil fertility research work in western Oregon. He earned his B.S., M.S., and Ph.D. at Washington State College, completing his Ph.D. in 1952.

By this time the moisture is generally exhausted on the shallower hill soils and the fat lambs are ready for market. Sheep farming is an ideal enterprise on such soils. Late summer feed for ewes can be supplemented with deep rooted perennial legumes and grasses on deeper soils.

Spring growth exceeding 3 tons per acre has been measured on clipping plots on these hill soils. Feed distribution is a major problem under these conditions and better production of winter feed will result in more efficient use of the high quality subclover-ryegrass production that comes during the spring months when the lambs are being fattened.

With improved rangeland pastures, farmers can carry two ewes per acre and market two lambs that will weigh from 90 to 100 pounds by the middle of June. At 19 to 20¢ per pound for fat lambs during early June, this can mean a return of about $35.00 per acre from fat lambs produced on improved rangeland.

At present, 3 to 4 acres are required to carry one ewe on the unimproved rangeland. **THE END**

New Alfalfa Movie

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PUTTING IT INTO ACTION

By George R. Gist **Ohio State University**

RESEARCH has convincingly shown how proper fertilization will increase forage yields and quality in the humid regions of the United States. But only a small percentage of farmers practice regular forage fertilization.

There is great need for an action program—a program designed to convince farmers that liberal forage fertilization can lead to lower production costs and higher farm profits. Field demonstrations and *inter-departmental teamwork* are essential to the success of such programs.

Field Demonstrations

Forage fertilization is a "natural" for field demonstrations. Such demonstrations add life and action to the program and serve as an excellent teaching technique.

Follow these four steps to a successful demonstration:

1 Organize for action—

One man cannot do the job alone. Work thru appropriate committees. Civic and business groups are often anxious to help.

Determine the practice to be demonstrated. KEEP IT SIMPLE.

Select the demonstrators. Be sure that they thoroughly understand all plans and procedures.

Dr. George Gist is project leader of the Ohio Extension Agronomy Staff. He earned his B.Sc. and M.S. from West Virginia, his Ph.D. from Purdue. He has the major responsibility for Extension work on forage crops in Ohio. He is vice-chairman of the Extension section of the American Society of Agronomy.

2 Apply the fertilizer—

Many farmer-demonstrators need assistance in calibrating spreading equipment.

The demonstration should always include a check (no fertilizer) area.

Make a sketch of the demonstration area and label the treatments. DON'T TRUST YOUR MEMORY.

3 Publicize the demonstrations—

Place signs along well-traveled roads. Supply newspapers, radio and TV stations with news and feature stories.

Organize a tour or meeting to see and discuss the demonstrations.

4 Determine yields—and dollars—

This may be a somewhat difficult step but is highly important.

Yields may be reported as pounds of forage, pounds of milk, or pounds of meat per acre from the fertilized and from the unfertilized areas. And, this forage, milk, and meat should be translated into dollar returns—from 100 acres, for example.

Inter-departmental Teamwork

For most farmers, greater forage production is only the first step to greater farm profits. The pay-off comes when this extra forage is marketed thru high-producing livestock.

In Ohio, Extension specialists representing the departments of Agronomy, Dairy Science, Animal Science, Agricultural Engineering and Farm Management have joined forces to form the Ohio Forage Committee.

This committee is conducting a coordinated

program of meetings, tours, and demonstrations encouraging more efficient production, harvesting, handling, feeding, and management of forage crops.

Recent projects of the committee have included:

1. A 3-day County Agent training school.

2. A series of county meetings held during the winter months featuring:

   Talks by Extension Specialists, County Agents, and farmers; Special exhibits; Distribution of literature prepared especially for these meetings.

   Two years ago these meetings emphasized general forage production. Last year hay was the central theme. This year silage will receive special emphasis.

3. A state-wide Ohio Silage Conference.

4. A series of pasture production demonstrations in which yields were measured in terms of milk per acre.

5. Farm tours on which visitors not only see improved meadows and pastures, but also hear discussions of the harvesting, handling, feeding, and farm management aspects of forage production and utilization.

There is abundant evidence that on many farms production costs can be lowered and profits increased thru more efficient production and utilization of forage crops. However, many farmers do not receive maximum returns from increased forage yields because a part of the crop is lost thru antiquated harvesting methods, the forage is fed to inefficient livestock, or is not utilized at all.

Educational programs should emphasize the yield potentials of forages and the management techniques necessary to receive maximum profits from forage production.

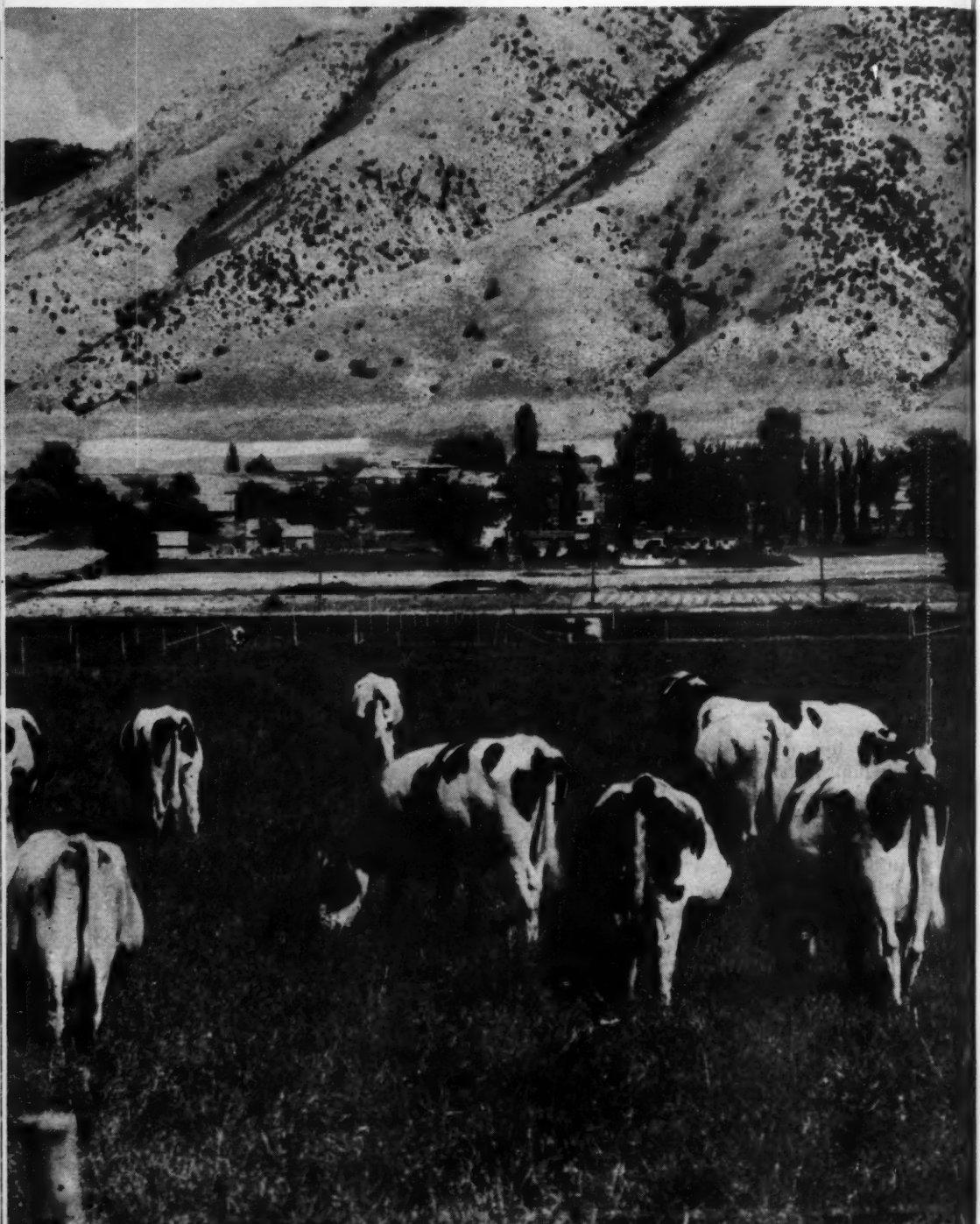
We are making progress—but there is much yet to be done. **THE END**

BY ORGANIZING PEOPLE AND PLANS

BY FERTILIZING WITH SYSTEM

BY DETERMINING YIELDS AND PROFITS

BY PUBLICIZING ON TOURS, IN MEDIA



FORAGES OF THE WEST

By Wesley Keller

Agricultural Research Service
U. S. Department of Agriculture

IN HUMID regions, fertilizers are a key part in any farm operation designed to return maximum yields and profits per acre.

But this key has not been used much on the western range, although it has permeated many parts of the range country via the scattered valleys where irrigation has made intensive agriculture possible. In fact, fertilization of any crop can probably be developed to the highest degree under irrigation, because plant response to fertilizers is closely correlated with the available water supply.

Facing a Cold Fact

This brings us face to face with a cold fact, well illustrated in the arid west. When water is the limiting factor in plant growth, there is no adequate substitute. But it should never be forgotten that any good practice including correct fertilization will *increase efficiency of water use by plants.*

Per acre production of herbage on the western range is low. Precise data are not available—the region is too large—but the most reliable approximations say between 100 and 150 pounds air-dry herbage per acre per year. Annual variations on any one site are large, due mainly to amount and seasonal distribution of precipitation.

Some locations are relatively productive, others very unproductive. Production ranges from zero to several thousand pounds per acre. The average, therefore, is highly theoretical. But with a low average, it is clear that high production is the exception.

Consider a range yielding 200 pounds air-dry herbage per acre in an average year perhaps with 10 to 12 inches of precipitation. Under the above conditions, 30 lbs. of nitrogen might increase this range's yield 100%. With even crude experimental techniques this is a highly significant increase. Nitrogen has essentially doubled the efficiency of water use.

But when applied to range lands, highly significant differences can be deceptive. They are easier to obtain than *profitable* differences. The additional 200 pounds of grass in this example cost more than $4. This means more than $40 per ton of hay standing on the range, not to mention the cost of applying the fertilizer.

Even if one application of 30 pounds N gets response for 3 years, adding 400 pounds of dry herbage, the cost still runs over $20 per ton of hay still on the range to be gathered in three harvests. If harvesting is done by grazing, the response to N will be reduced.

Up to the Rancher

But there are conditions under which such treatment might be worthwhile. The date of range readiness may sometimes be advanced two weeks or more. If a rancher is out of feed and has no other place to turn, this could "pull him through."

In mountain valleys of the West, irrigated pastures provide the foundation for an efficient dairy enterprise, demonstrating great potential for beef cattle and sheep production.

Fertilized range often responds with a protein content above unfertilized range and adequate to meet the needs of growing animals—a "hidden value" which should not be overlooked. Thus to appraise properly range fertilization, each rancher must analyze his own situation and needs.

Total and seasonal distributions of precipitation are the most important environmental factors. After these, temperature, water-holding capacity of soil within the root zone, and the species present all contribute to the range's capacity for responding to fertilization.

Broadly considered, even a somewhat better than average range in the arid West will not, by present standards, justify the application of commercial fertilizer.

Profitable Response Areas

Since range forage production depends so much on moisture, we must naturally look to those parts of the Western States where water is not so drastically limited for major areas that will respond profitably to fertilizer. In addition to the Pacific Northwest, four of these stand out:

1 NORTHERN GREAT PLAINS, EASTERN PART

In the eastern part of the Northern Great Plains, precipitation is between 14 and 20 inches, with 12 inches or more coming during the growing season. Since average temperatures are relatively low, the available water is used with comparatively high efficiency by the vegetation.

In an old crested wheatgrass pasture at Mandan, North Dakota, the yield of unfertilized plots was increased 285% by annual application of 60 pounds N per acre. This increase was equivalent to 28 pounds of grass per pound of N. One pound of beef was produced for less than 8 pounds of dry matter consumed. Thus 28 pounds of grass per pound of N is like trading a pound of N for more than 3 pounds of beef. Also, this spring and early-summer use of crested wheatgrass provides early-season deferment of native range, a very good range-improvement practice.

In this region, one-fifth to one-fourth of the grazing land on a ranch should be in crested wheatgrass for early-season use. Nordan variety is superior for this purpose.

Even where crested wheatgrass is not present, native range also responds to N. But the species composition will change.

Late-fall application of 30 pounds of N each year increased native range production approximately 600 pounds (average of 6 years). This was approximately 20 pounds of additional grass per pound of N.

In another study, native range fertilized with 40 pounds N per acre per year produced 1 pound of beef for just over 8 pounds of forage (dry-weight basis) consumed. Unfertilized native range required over 12 pounds forage per pound of beef. Thirty pounds N per acre on native range thus represents a trade of 1 pound N for at least 2 pounds beef. The fertilized range was ready for grazing 10 days earlier.

IN PROFITABLE RESPONSE AREAS, WESTERN RANGE FE

2 MOUNTAIN MEADOWS

There are about 3½ million acres of mountain meadows, essentially small mountain valleys that flood in the spring and early summer but can become very dry by late summer. Flooding is the process by which melting snow ultimately passes over the meadow on its way to a stream or a river.

In some areas a variable degree of water control is possible. Mountain meadows have high production potential because of abundant early-season water. However, under old-type man-

agement these meadows yield only a ton of hay per acre or even less.

Under average conditions in Colorado, 160 pounds N applied to unimproved meadows increased hay yield 1 ton. If N costs 15c per pound, this is $24 per ton for the fertilizer alone. However, the protein content of the hay is also increased. If unfertilized hay has a protein content below 10%, fertilization may well be justified.

Wherever the meadow can be managed to maintain a legume, this is the cheapest way to produce hay with adequate protein. Alsike and red clovers are widely adapted for this use. In eastern Oregon, whitetip clover has proved valuable. Wherever water control is possible, seeding productive species of grasses and legumes has great potential for increased production from mountain meadows.

3 ANNUAL-TYPE RANGE IN THE GREAT CENTRAL VALLEY OF CALIFORNIA

In the foothills of the central valley, precipitation may be as high as 20 or more inches during the winter season followed by very long, dry summers. In such an area, range fertilization combined with productive seed species have yielded phenomenal returns.

At California's Hopland Field Station, scientists reported more than a 10-fold increase in production—from 335 pounds per acre (on the natural range) to 3938 pounds by seeding adapted grasses and clovers and applying 16-20-0 fertilizer at the rate of 83 pounds N per acre.

In another study in Placer County, where winter precipitation is over 16 inches, seeding adapted legumes and applying 200 pounds single superphosphate increased carrying capacity 3+ fold with unfertilized plots yielding under 1000 pounds dry forage per acre and the more effective treatments over 4000 pounds.

Fertilizing the annual-type range in California is becoming a widely accepted practice.

4 IRRIGATED PASTURES

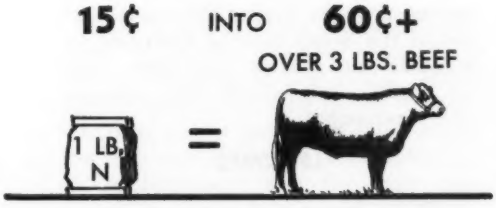
Irrigated pastures first demonstrated their high forage-producing potential with dairy cattle and have now moved to beef and sheep.

Only a few years ago irrigated pastures were relegated to land unsuited for cultivated crops. Today's irrigated pasture is deliberately put on the best available land as part of a rotation system calculated to improve the productive capacity and income of the entire farm.

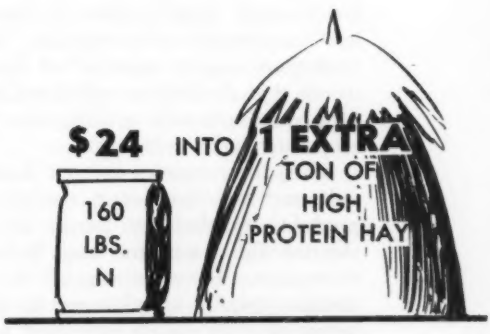
Maintaining good irrigated pastures

CONTINUED ON PAGE 40

FERTILIZATION MEANT . . .



Northern Great Plains, eastern part



Mountain Meadows

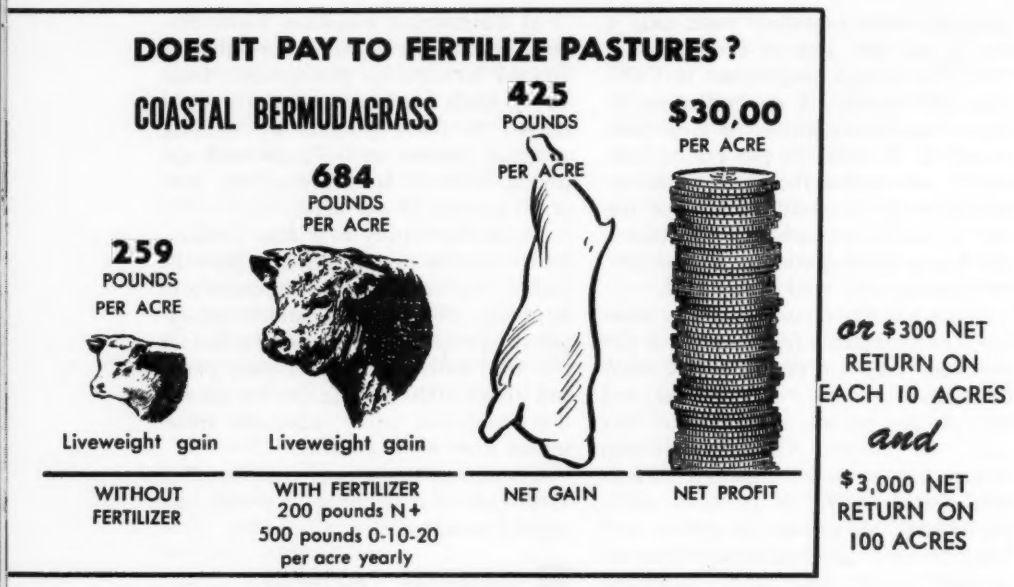


Figure 1—In a 3-year grazing experiment, approximately $35 worth of fertilizer gave an additional 425 lbs. of liveweight gain per acre. This increased gross income $80.75 and net income $30 per acre after *all* costs.

WARM SEASON P

By Glenn W. Burton Tif

Who asks:

"Can you afford to fertilize improved pastures?"

MANY species that grow in the South supply some warm season grazing. Millions of acres of the native range, associated in most instances with timber production, are grazed during the spring and summer. But the quality of this grazing is poor and the per acre production very low.

The failure of the species in the native range to respond to fertilization and the increasing value of timber are causing these species to become less important with passing time. Crabgrass and a number of annual weeds that develop in cultivated fields supply considerable grazing after the crops are harvested.

Since these species are not dependable and may be low in quality and productivity, they can hardly be considered the basis for any livestock enterprise. They do furnish an important grazing supplement on many farms and, of course, are best when following well-fertilized crops.

The species currently used in improved pastures during the warm season in the South may be classified as *legumes* and *grasses*, and these may be further subdivided into *annuals* and *perennials*.

LEGUMES

Lespedeza

The most important warm season

pasture legume genera is *Lespedeza.* The annual varieties are seeded with small grain supplying grazing, seed, or hay after the small grain is harvested. They also reseed to a limited extent in perennial grass pastures (particularly common Bermuda grass) that are not fertilized with nitrogen in the summer.

They are best adapted in the Tennessee-North Carolina area and are used very little in the deep South. The per acre production is usually rather low, but the forage quality is considered very good.

Sericea lespedeza is a perennial form of this genus that is well adapted throughout much of the South. Although the quality of Sericea lespedeza is a controversial subject among livestock farmers, all agree it is a valuable reserve crop to supply grazing during dry periods. The lespedezas grow best on the heavier soils and require moderate amounts of phosphorus and potash for satisfactory growth.

for a number of years for the crop to be profitable. Since most farmers have been unable to do this, very little Kudzu is being planted for pasture at the present time.

GRASSES
Annuals

Pearl Millet

The most important summer annual grass used for grazing in the South is pearl millet, *Pennisetum spicatum (L) willd.* It may be planted with a grain drill, but on weedy fields it will give the best results if planted in 20″ to 36″ rows to permit cultivation.

It is adapted to a wide range of soils and will make more growth than most plants on poor soils. But for satisfactory performance, it should receive *a minimum of 100 lbs. of N per acre and 300 to 500 pounds of 0-10-20 or its equivalent.* Millet has a high potash requirement and takes on a diseased appearance when this element is in short supply.

N PASTURES IN THE SOUTH

on **Tifton, Georgia**

And answers:

"When you consider the costs of establishing improved pastures, you cannot afford *not* to fertilize them!"

Kudzu

Kudzu, with proper management, could be a very valuable warm season pasture crop in the South. Most farmers who have tried to use it have lost it in one or two years by grazing too early or too much. The high cost of establishment and the time required to get a field ready for grazing require that stands be maintained

Late April or early May has been the best planting season in the latitude of Tifton, Georgia. Where top-quality (young) forage for lactating cows is desired throughout the summer, plantings should be made in June and July. Older plantings can be used for dry cows and young stock, or can be cut for silage. Pearl millet should be grazed rotationally, whenever 20 to 30 inches tall. Close grazing should be avoided.

Three varieties—*common, Starr* and *Gahi 1*—occupy most of the acreage planted to this species. Starr and Gahi 1 are leafier and later maturing and supply grazing for a longer period of time than the common type. Starr is a synthetic variety that is easier to manage than Gahi 1. Gahi 1 is a hybrid that starts off faster in the spring, recovers faster when

* Numerals in Bars indicate cutting frequency—3, 4, 6, 12 weeks.

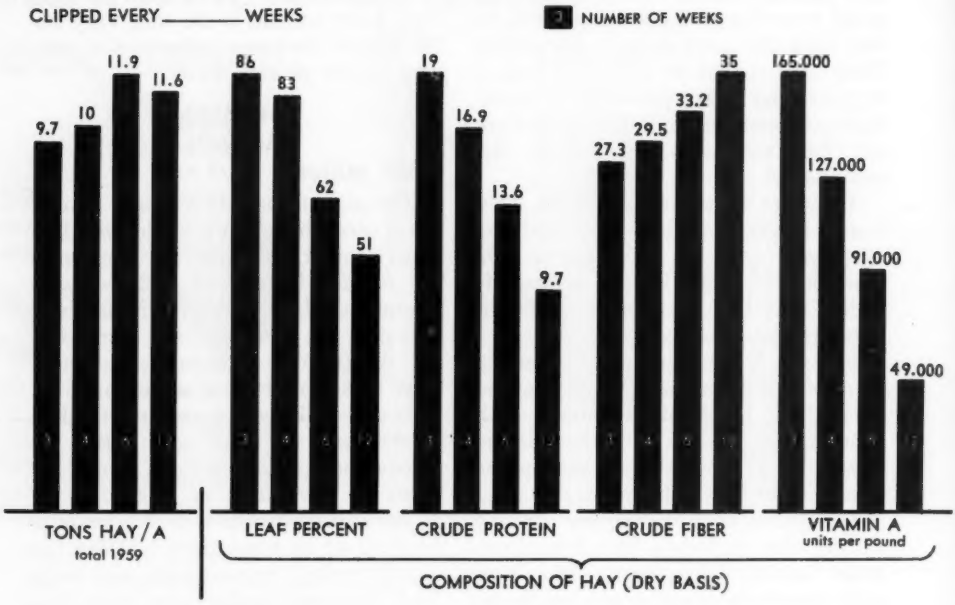


Figure 2—How cutting frequency affected Coastal Bermudagrass fertilized with 600 lbs. N per acre and 1500 lbs. 0-10-20 in 1959.

grazed or mowed, and yields considerably more forage per acre per year than Starr. As a consequence, it will grow taller than Starr and may get ahead of the cattle if not stocked at a heavier rate or mowed to keep it in a palatable condition.

Sudan Grass

Sudan grass, widely used as a summer annual in the north, is much less productive than pearl millet in the deep South. It grows better than pearl millet at low temperatures and may be superior for early plantings in the cooler sections of the South.

It has a high phosphorus requirement and makes very little growth on poor soils. It may be planted with a grain drill or in cultivated rows but does not compete as well with weeds as Gahi 1 millet and in weedy fields will do best in cultivated rows.

It should be grazed rotationally. There are a number of foliage diseases that attack Sudan grass and reduce the yield and quality of the forage. Tift and Piper are the most disease resistant of the many varieties that are available, and should be used whenever Sudan is grown in the humid South.

Browntop Millet

Browntop millet, *Panicum fasciculatum Swartz,* is a short-season, low-growing annual used for summer pasture and hay. In some areas it is used as a volunteer crop with reseeding crimson clover to supply two periods of grazing per year on the same land.

The hard seeds that enable browntop millet to reseed also make it a pest when it is followed with other cultivated crops. Since browntop millet yields much less and supplies grazing for a shorter period of time, most

Table 1. Effect of nitrogen and potash upon the yields of Coastal Bermuda grass on a fertile Tifton loamy sand over a six year period.

Nitrogen applied pounds per acre per year	Number of years before important yield reductions occurred with annual per acre applications of K_2O of *:	
	0	100 pounds
100	6+	6+
200	4	6+
400	2	3
800	1+	2

* When compared with plots receiving the same amount of N and 200 pounds of K_2O per acre per year. Soil contained 160 pounds per acre of available K_2O as determined by the flame photometer when test was begun.

farmers consider pearl millet a superior pasture crop.

Perennial Grasses

Bermuda Grasses

Perennial grasses generally form the most dependable basis for any livestock feed production program.

The most important of these perennials in the South is Bermuda grass. Not only does it occupy millions of pasture acres in nearly pure stand, but it may be found to a lesser or greater degree in most every acre of improved pasture in the area. Most common Bermuda pastures were developed by turning cultivated fields heavily contaminated with this grass into pastures.

As might be expected, the productivity of these pastures is determined largely by the fertility of the soil and the amount of fertilizer applied.

Coastal Bermuda

Farmers planting Bermuda grass pastures generally plant one of the improved varieties that yield more. The most important of these, Coastal Bermuda grass, now occupies some three million acres extending from the Atlantic to the Pacific.

This grass is resistant to disease, root knot nematode, and drought. It yields over 100 pounds more liveweight gain per acre than common Bermuda, is more efficient in fertilizer and water use than other commonly grown grasses, and grows tall enough that it may be cut for hay.

Although it must be propagated vegetatively, farmers are planting it for as little as $1.50 per acre by using sprigs from their own pastures.

Coastal Bermuda has tremendous yield potential and when heavily fertilized under good growing conditions

Dr. Glenn W. Burton is Principal Geneticist on forage crops research at Georgia's Coastal Plain Experiment Station. Best known of the new grasses he and his associates have developed is the Coastal Bermuda variety for which he received the John Scott Award in 1957.

has produced over 13 tons of hay per acre.

Although certain data suggest that nitrogen is the nutrient responsible for this growth, table 1 clearly shows that nitrogen alone could not do it unless other necessary nutrients were present in adequate amounts in the soil.

For example, when 800 pounds of N/A/year were applied to Coastal Bermuda grass growing on this fertile Tifton soil and no potash was added, yields declined significantly during the second year. Four years of this fertilizer program reduced soil potash so low that yields were about half those from plots getting only 100 pounds of N per acre, but adequate potash. A deficiency of any other essential element could have caused a similar reduction in yield.

This and other experiments suggest that the phosphorus and potassium requirements of this grass will generally be satisfied by a 4-1-2 ratio of N, P_2O_5, and K_2O. This assumes that soil deficiencies revealed by soil test have been corrected.

If the P_2O_5 comes from superphosphate and if the soils are limed with dolomitic lime as needed to keep the pH close to 6.0, the sulfur, calcium, and magnesium needs of the grass will also be met. Although Coastal Bermuda grass has failed to respond to trace element application at Tifton, Georgia, it is reasonable to suppose that it would respond to such applications on some very light soils.

In addition to increasing yields, fertilizer (particularly nitrogen) increases the protein content of Coastal Bermuda and other grasses. Numerous experiments show the protein content of Coastal Bermuda harvested from unfertilized plots can be doubled by adding 600 to 900 pounds of N per acre per year.

Cutting frequency has an even greater effect on most of the factors that determine forage quality. Figure 2 shows that Coastal Bermuda grass must be cut frequently if it is to produce top quality hay and must be managed to prevent the development of old stemmy growth if it is to supply the best grazing.

Suwannee Bermuda, on deep sands, has consistently out-yielded Coastal Bermuda. But it is less winter hardy than Coastal Bermuda and should replace it only in the lower part of the Bermuda grass belt.

Midland Bermuda grass is more winter hardy than Coastal and should generally be used north of a line drawn from southeast Virginia through middle Tennessee and northern Arkansas.

All of these varieties must be propagated vegetatively but are enough better than common Bermuda to pay large dividends on the efforts expended in planting them.

Dallis Grass

On the heavy soils of the Blackbelt and the Mississippi delta, Dallis grass is widely used in improved pastures. It is better adapted to wet soils than the Bermuda grasses, but it is much less drought resistant and usually fails on the light soils.

Dallis grass has a high fertilizer (particularly phosphorus) requirement and grows best at pH above 6.0. It is usually grown in association with white clover and in this combination makes an excellent pasture. Allowing Dallis grass to produce a seed crop greatly reduces the stand because of a combination of disease and the weakening effect of

seed production. So, Dallis grass pastures should be grazed heavily enough to prevent seed production.

Bahia Grass

In Florida and the southern part of the Gulf states including Georgia, Bahia grass, *Paspalum notatum Flügge*, has become a popular grass with a number of farmers.

It is a well adapted species that soon crowds out weeds and other grasses. This grass seeds profusely during the summer and is spread by cattle through their droppings wherever they go. As a consequence it will crowd out other grasses, including Coastal Bermuda, and restricts future pasture use of the land largely to this species.

Of the several varieties that have been named, Pensacola is the most drought resistant and winter hardy, occupying most of the acreage planted to this species. Grazing and clipping studies indicate that it is equal or superior to other Bahia grasses such as Argentine and common. Consequently the following remarks will be restricted to Pensacola Bahia.

Ten pounds per acre of good quality seed planted in a well prepared seedbed in February or March will usually give a satisfactory stand. Bahia grass is less drought resistant than the Bermudas and grows best on the wetter soils. Although it will survive and make some growth on poor soils, it must be fertilized for efficient production. Fertilizer studies indicate that it can utilize up to 100 pounds of N per acre per year quite efficiently, but is considerably less efficient than the better Bermudas at higher nitrogen levels. The statements relative to the needs of Coastal Bermuda grass for other elements also apply to Pensacola Bahia grass.

Pensacola Bahia is sometimes cut for hay but is not considered a very satisfactory hay plant. A new hybrid Pensacola Bahia, Tifhi 1, capable of producing about 15% more than Pensacola, has been released and will be available in limited supply in 1961.

Pangola Grass

Pangola grass, *Digitaria decumbens Stent*, a perennial introduced from Africa, has become an important pasture grass in peninsular Florida. Restricted to this area because of its susceptibility to winter killing, this grass is considered by many to be tops for grazing. Its complete sterility makes vegetative propagation necessary, but its rapid spread makes this an inexpensive operation.

The absence of seed and rhizomes (it spreads by above-ground stolons) makes Pangola an easy grass to control and eradicate. Soil and fertilizer recommendations for Pensacola Bahia grass would also apply to Pangola grass. It is used for hay to a limited extent, but is more difficult to cure than Coastal Bermuda grass because of its higher moisture content.

Johnson Grass

Johnson grass, *Sorghum halepense (L.) Pers.*, although seldom planted, is used (particularly in the Blackbelt) for hay and pasture purposes. Since continued heavy grazing reduces stands, it should be grazed rotationally for best results. Johnson grass should be cut when the first heads begin to appear for best quality hay. It is similar to Sudan grass in nutrient requirements and must be well fertilized if high yields are desired.

It Pays to Fertilize

Does it pay to fertilize pastures? This question, asked again and again by farmers, is not an easy one to answer because of the complexity of the beef cattle enterprise.

Since Coastal Bermuda will utilize fertilizer more efficiently than other grasses adapted to this area, it should be the grass most likely to pay for the use of fertilizer.

CONTINUED ON PAGE 48

AN ANNUAL RANGE HAY YIELD

NOT FERTILIZED (882 LBS/A) **FERTILIZED (3,872 LBS/A)**

FORAGES OF WEST—CONTINUED FROM PAGE 33

depends on regular fertilization and other management practices, such as rotation or daily ration grazing which allows a grass + legume mixture to yield its best.

In the arid West where legumes are very well adapted there is little likelihood that many farmers or ranchers will ever adopt grass alone. The reason is that even if herbage yields are as good from grass alone, *animal performance is better when legumes are in the diet and the cash outlay for fertilizer is less.*

Some Management ABC's

Grass + legume mixtures require careful management to avoid loss from bloat. A few basic facts must be kept clearly in mind as follows:

Dr. Wesley Keller is Research Leader of Arid Pasture and Range Investigations of the Agricultural Research Service, U. S. Department of Agriculture at Beltsville, Md.

1 Legumes are less apt to cause bloat if they approach mature size before being grazed. This means pastures in middle latitudes should be grazed not more than 4 times a season.

2 High concentration of animals in a pasture, as under daily ration grazing, reduces the opportunity for selective grazing. This lessens the likelihood of bloat.

3 Livestock should not be placed in a lush pasture containing legumes when they are hungry or when a heavy dew is on the foliage. This precaution particularly applies to large dairy herds since the cows are taken twice daily from the pastures to be milked.

4 If the above precautions are observed, pastures containing 50 to 60% legumes should be safe to graze. Pastures of pure alfalfa or Ladino clover are sometimes grazed, but the risks

are rather high and this practice cannot be recommended. Birdsfoot trefoil has attracted considerable attention, because of reports that it does not induce bloat in livestock. This species has produced well in recent pasture-mixture studies in Montana.

Deserves Much Research

Fertilization of irrigated pastures merits much additional research. It is doubtful now whether anyone has applied adequate fertilizer to determine what maximum production may be. Potential production appears to be somewhere between 1500 and 2000 pounds beef or mutton or the herd average in pounds butter fat per acre per year.

A long-standing recommendation of Professor George Q. Bateman of the Utah Agricultural Experiment Station, our top expert on irrigated pastures, maintains fertile land at a high level of productivity, is economical, and does not materially alter the proportion of grass to legumes in a pasture rotationally or strip grazed. It consists of 10 tons manure (accumulated under open shed housing, with enough straw to keep animals clean) and 200 pounds treble superphosphate per acre, each second or third year.

Mixtures for irrigated pastures are by no means cut-and-dried. In the high-altitude valleys of the West, and on the western great plains, the more productive species have been fairly clearly identified. These include orchardgrass, smooth bromegrass, reed canarygrass, alfalfa, and Ladino clover as long-lived species and tall oatgrass and red clover as short-lived ones. Tall fescue is a long-lived grass that may be added to the list when strains with acceptable palatability are available.

Forage is one of the great resources of the West and, until some revolutionary development (such as weather control) changes the character of the region, it will continue so.

THE END

CHECK YOURSELF

Yes____ No____

Some questions to determine how much this article interested and informed you.

1 Any good practice including correct fertilization will increase efficiency of water use by plants.

yes____; no____

2 Per acre production of herbage on the Western range is high.

yes____; no____

3 Fertilized range often responds with a protein content above unfertilized range—a hidden value important to growing animals.

yes____; no____

4 Whenever the meadow can be managed to maintain a legume, this is the cheapest way to produce hay with adequate protein.

yes____; no____

5 High concentration of animals in a pasture, as under daily ration grazing, increases the likelihood of bloat.

yes____; no____

6 Maintaining good irrigated pastures depends on regular fertilization and other management practices.

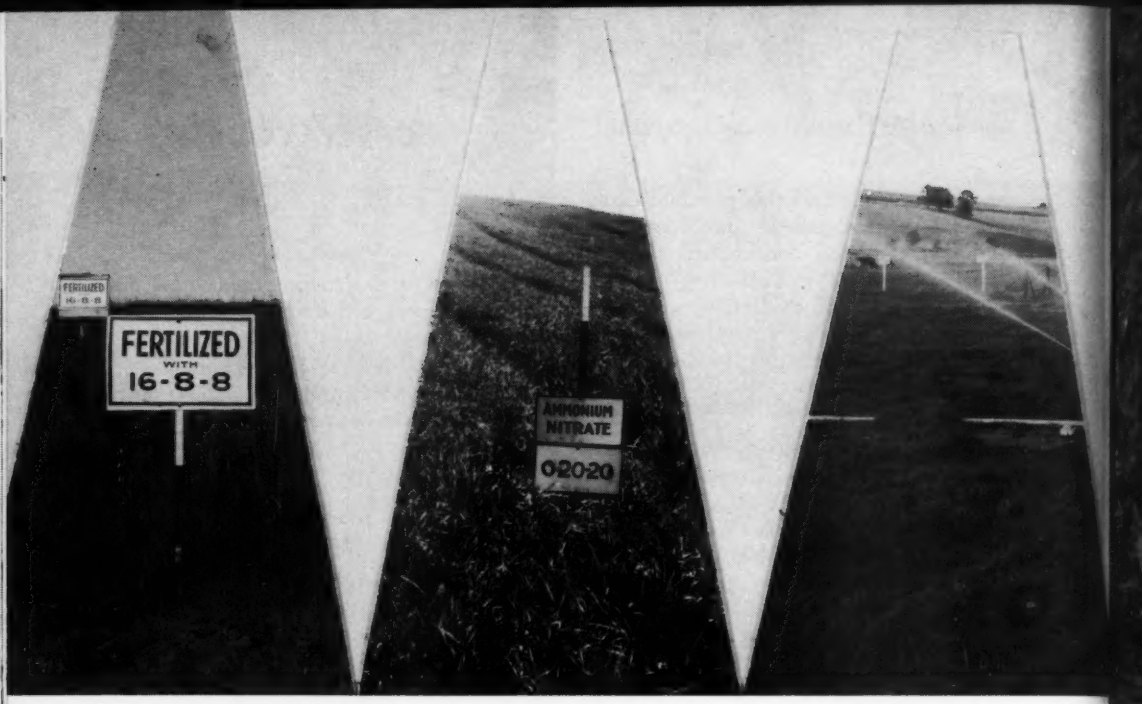
yes____; no____

7 Livestock should be placed in a lush pasture containing legumes when they are hungry and when a heavy dew is on the foliage.

yes____; no____

8 Animal performance is better when legumes are in the diet and the cash outlay for plant nutrients is less.

yes____; no____



NITROGEN + MINERALS + WATER

IMPROVING P

MILLIONS of acres of grass pastures in the northern states are non-productive and have been for many years, providing little more than fresh-air exercising grounds for livestock.

The livestock-carrying capacity of these pastures could be doubled and possibly tripled by simply doing one of these things:

(1) By introducing a good renovation program of lime, fertilizer, and productive legumes—and sometimes grasses.

(2) By directly fertilizing the existing stands.

(3) Or by a combination of both practices.

By Renovation

Pasture improvement by renovation calls for the establishment of legumes (alfalfa, ladino and/or sweet clover and other adapted legumes) along with brome, orchard or other improved types of grasses in our millions of acres of unproductive old permanent grass pastures.

On a long-time basis, pasture improvement by renovation offers the livestock farmer a great opportunity not only for increasing the livestock-carrying capacity of these pastures but also for improving the quality of the forage on such pastures.

For successful pasture renovation do these things:

1 Apply lime and fertilizers as indicated by soil tests.

2 Fit a good seedbed by ripping and tearing the old sod with field cultivator and/or disc (fall application of lime and seedbed preparation recommended). Prepare fields where erosion is not a serious problem by plowing and discing.

3 Seed with mixtures of alfalfa, ladino, brome, orchard grass, timothy or other adapted grasses. Firm the

= HIGHLY PRODUCTIVE PASTURES

G PERMANENT PASTURE BY FERTILIZATION IN NORTHERN STATES

By
C. J. Chapman
University
of
Wisconsin

seedbed with a cultipacker or roller after seeding, especially where prepared with field cultivator and disc. Pasture off oats as a nurse or companion crop in early July.

4 Fence cattle out of renovated areas (except for short period when nurse crop is being grazed off) until fall—then graze judiciously.

(Bloat may be a problem where cattle are turned in for the first time. The lush growth of alfalfa and ladino in wet weather is a serious hazard and farmers should watch their cattle carefully and at the same time give them access to dry feed during the early period of grazing.)

5 Topdress periodically to maintain good production.

By Direct Fertilization

But now, what about this short cut to *abundant, protein-rich, palatable grass pasture* by applying fertilizers such as 10-10-10, 15-10-10, 16-8-8 or similar combinations of nitrogen, phosphate, and potash?

One of the still untouched and almost unlimited opportunities for pasture improvement is wide open to farmers *through direct fertilization.*

Dr. H. J. Wheeler, once Director of the Rhode Island Agricultural Experiment Station and later Chief Agronomist for a large Eastern fer-

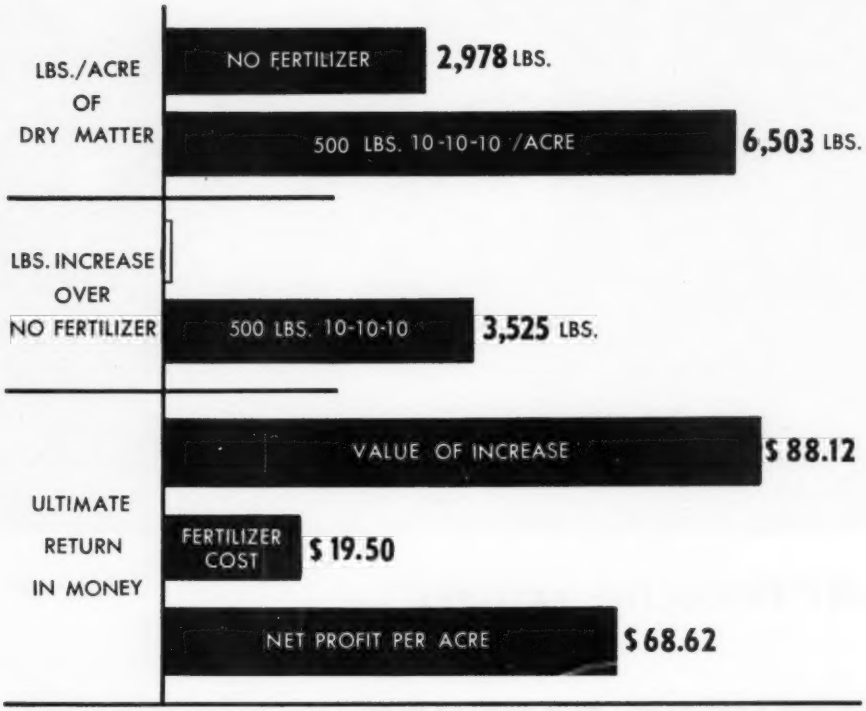


Figure 1—Average per acre yields and profits from 474 acre-scale pasture or hay plots—1951 through 1958—fertilizer applied broadcast early spring.

*** Net here indicates return less fertilizer cost.**

tilizer company and (one of the early advocates of pasture improvement through nitrogen and minerals) used to dramatize the opportunities for low unit cost forage by telling the following story:

"Gentlemen," he would say, "if I were to tell you that by applying a ton of high nitrogen fertilizer on about 5 acres of your grass pastures at a cost, let's say, of about $70-$80, that six weeks later you could go out with a truck and pick up six or seven tons of bran all bagged up for you, you'd all do it, wouldn't you? My story is actually better than that, for all you have to do is to open the gate into that pasture, let your cows pick up this high-protein bran-equivalent feed and convert it into milk for you."

Minerals Important As Nitrogen

Repeated trials in Wisconsin and other states show continuous use of straight nitrogen depletes mineral reserves in the soil. In northern Wisconsin demonstrations, we invariably got small yield increases from ammonium nitrate on *mineral deficient soils.* Pastures on such soils would turn a dark green color but would make very little extra growth. *When these nitrogen-treated plots were given an application of 0-20-20 or 0-20-0 fertilizer,* yields were doubled and frequently trebled, with *profit over and above cost of fertilizer more than doubled.* See Figure 3.

Straight nitrogen can be used in many forms, all satisfactory sources. But farmers should be sure to *supply the minerals needed to back up this nitrogen.* Test the soil at frequent intervals to make sure the supply of P and K is adequate.

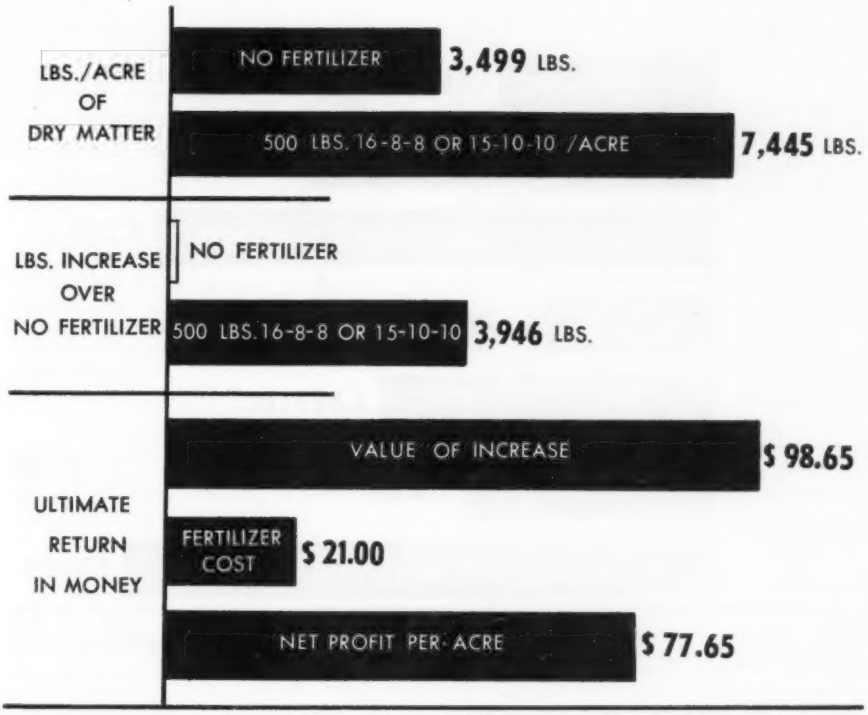


Figure 2—Average per acre yields and profits from 57 acre-scale plots in 1958 and 1959—fertilizer applied broadcast in early spring.

*** Net here indicates return less fertilizer cost.**

Fertilizing Grass Pays

Over a period of the past 10 years, Wisconsin county agents, in cooperation with selected farmers in their counties, have carried out close to a thousand acre-scale demonstrations with high nitrogen mixtures. The results of all of these demonstrations give us overwhelming proof that it does pay to fertilize pastures.

In Figure 1 are the averages for *all* the 10-10-10 (or other 1:1:1 ratio) top-dressing plots from which yield data was secured. In this summary of both good and poor plots, we show an average increase in yield of 3,525 pounds of grass (dry matter) equivalent in feeding value to a 16 to 18% dairy feed supplement. (Analysis of the nitrogen-treated grass in the green succulent grazing stage has shown it to carry up to 20 and even 22% crude protein.)

In 1958, we shifted from the 1:1:1 ratios to a 2:1:1 ratio of nitrogen to phosphate and potash. And the average results of some 57 of these demonstrations show an increase over the check plot of 3,946 pounds of grass. See Figure 2. This 2:1:1 ratio may be a bit short on potash, since some agronomists in the Eastern and Southeastern states suggest the 4:2:3, 3:1:2 or 4:1:2 ratio of nitrogen to phosphate and potash.

Remember Actual Pay-off

In Figures 1 and 2, we have figured the value of the increase in yield of grass at $50 per ton. I know some will argue that this is too high—that $30 per ton would be more nearly the true value of this extra feed. But remember that the *actual pay-off from the fertilization of grass pasture is measured in pounds of extra milk or*

HAY OR PASTURE YIELD PER ACRE
NO FERTILIZER
1,860 LBS.
200 LBS. AMMON. NITRATE PER ACRE
3,289 LBS.
200 LBS. AM. NIT. plus 250 LBS. 0-20-20/ACRE
4,749 LBS.
PER ACRE INCREASE OVER NO FERTILIZER
200 LBS. AM. NIT.
1,429 LBS.
200 LBS. AM. NIT. plus 250 LBS. 0-20-20
2,889 LBS.
PROFIT OVER FERTILIZER COST
200 LBS. AM. NIT.
$12.43
200 LBS. AM. NIT. plus 250 LBS. 0-20-20
$30.33

Figure 3—Average per acre yields and profits from 29 hay or pasture plots —1945, 1946, 1947.

meat that this extra feed will produce.

To secure information on the value of high nitrogen mixture and express it in terms of actual gain in milk production, I have conducted (over a period of several years now) 8 large-scale pasture demonstrations where a whole pasture field was used for the demonstration and in some cases a group of selected milk cows or the whole herd was used to carry out the experiment.

The cattle were then rotated from the fertilized to the unfertilized areas and a record kept of the number of days of grazing, as well as the pounds of milk produced on each half. When figured as extra milk, the payoff was about five-to-one and considerably greater than when figured only as extra feed.

PASTURE FERTILIZING PAYS, 10 REASONS WHY:

1 Because a pasture's carrying capacity can be doubled or tripled by renovating it through fertilization and reseeding with alfalfa, Ladino, and brome—offering a great opportunity to the livestock farmer.

2 Because nitrogen plus phosphate and potash will produce not only a lush, early growth of grass but will also extend the pasture season into late July . . . and even though dry weather stops growth, the accumulated dry grass still has a high feeding value to furnish good feed for livestock during the dry period of the summer.

3 Because pasture improvement by direct fertilization with 15-10-10 or 10-10-10 or straight nitrogen (backed up with minerals) is economically sound . . . a simple, easy-to-do program answering a vital need on livestock farms.

Prof. C. J. Chapman, Wisconsin native and well-known University of Wisconsin soils specialist, has carried the story of better farming methods to his people for nearly 4 decades. Conducting thousands of fertilizer and lime demonstrations on alfalfa, small grain, and corn, he has influenced major crop yields. He has contributed important articles to this magazine for the past 32 years.

4 Because a fertilized pasture is more palatable (tastier to the cattle), the feed richer in proteins and minerals, as well as vitamins.

5 Because a thickened turf increases water penetration and slows down losses from run-off.

6 Because a fertilized pasture is healthy enough to choke out many kinds of weeds.

7 Because more feed from fertilized pasture reduces cash outlay for protein feed supplements.

8 Because more pasture acres give the farmer good soil conservation in a grassland farming program, while reducing man-hours and machinery costs by letting the cows harvest their own feed.

9 Because irrigation can be profitably used to help keep the pasture supplying low-cost feed to livestock during the whole season.

10 Because the farmer gets quick, direct returns on his invested dollars.

THE END

CHECK YOURSELF

Yes_____ No_____

Some questions to determine how much this article interested and informed you.

1 A good short cut to abundant, protein-rich, palatable grass pasture is direct fertilization with a balanced plant food.

yes_____; no_____

2 Nearly 1,000 acre-scale demonstrations in Wisconsin over the past 10 years have proved it pays to fertilize pastures.

yes_____; no_____

3 it is not necessary to test the soil at frequent intervals to make sure the supply of phosphate and potash is adequate.

yes_____; no_____

4 A pasture's carrying capacity can be doubled or tripled by renovating it through fertilization and reseeding with alfalfa, ladino, and brome.

yes_____; no_____

5 Millions of acres of grass pastures in the Northern states are highly productive, providing palatable, protein-rich diets to dairy and beef cattle of area.

yes_____; no_____

6 Repeated experience shows that continuous use of straight nitrogen depletes mineral reserves (P and K) in the soil.

yes_____; no_____

7 The actual pay-off from fertilizing grass pastures is measured in pounds of extra forage rather than pounds of milk or meat.

yes_____; no_____

8 A healthy, thickened turf can increase water penetration, slow down run-off losses, and choke out weeds.

yes_____; no_____

CHECK YOURSELF

YES____ No____

Some questions to determine how much this article interested and informed you.

1 The per acre production of lespedeza is usually rather low, but the quality of the forage is considered good.

yes____; no____

2 Most farmers who have tried to use kudzu have succeeded by grazing early and heavy.

yes____; no____

3 Pearl millet has high potash requirement and gets a diseased appearance when K is short.

yes____; no____

4 The tremendous yields (of 13 tons hay/A) which coastal bermuda grass is capable of giving cannot come from N fertilization alone, but from adequate supplies of the other nutrients (P & K) in the soil to *balance* with the nitrogen.

yes____; no____

5 Dallis grass has a high fertilizer requirement and grows best at a pH above 6.0.

yes____; no____

6 Since bahia grass will survive and make some growth on poor soils, it does not need to be fertilized for efficient production.

yes____; no____

7 Because of the way it spreads (by above-ground stolons), pangola grass is not easy to control or eradicate.

yes____; no____

8 With proper fertilizer-management (such as 200 lbs N and 500 lbs 0-10-20 per acre annually) coastal bermuda pastures can net a farmer such gains as 425 additional liveweight pounds per acre . . . or $30 *net* profit per acre . . . or $300 *net* from each 10 acres . . . or $3,000 *net* from each 100 acres.

yes____; no____

WARM SEASON GRASS—CONTINUED FROM PAGE 39

In a three-year grazing experiment run at the Georgia Coastal Plain Experiment Station, Coastal Bermuda pastures without fertilizer gave an average live weight gain per acre per year of 259 pounds. Pastures on the same Tifton soil fertilized with 200 pounds of N and 500 pounds of 0-10-20 annually gave average liveweight gains of 684 pounds per acre per year. Thus approximately $35 worth of fertilizer gave an additional 425 pounds of liveweight gain. At 19 cents per pound, the current average price for steers from such pastures, the increase in gross income per acre from the fertilizer applied would equal $80.75.

Subtracting the cost of the fertilizer leaves $45.75 to cover other costs and any profit that might be left. Most other costs such as land, fence, water, mowing, etc., would not be increased in the fertilized pastures and hence need not be charged against the $45.75.

More capital would be required to buy additional cattle and fertilizer and a very small additional charge for labor for managing these animals would be necessary. If one assumes that these additional costs would not exceed $15 to $20 (which seems a reasonable assumption), one should realize $25 to $30 per acre profit from fertilizing Coastal Bermuda pastures under the current price structure.

Other pasture plants less efficient in fertilizer use would return lower profits and changes in the price structure would, of course, alter the profits realized.

Can you afford to fertilize improved pastures? If you consider the costs of establishing improved pastures, you cannot afford *not* to fertilize them.

For more details on the culture and management of improved pastures contact your county agent or your Agricultural Experiment Station.

THE END

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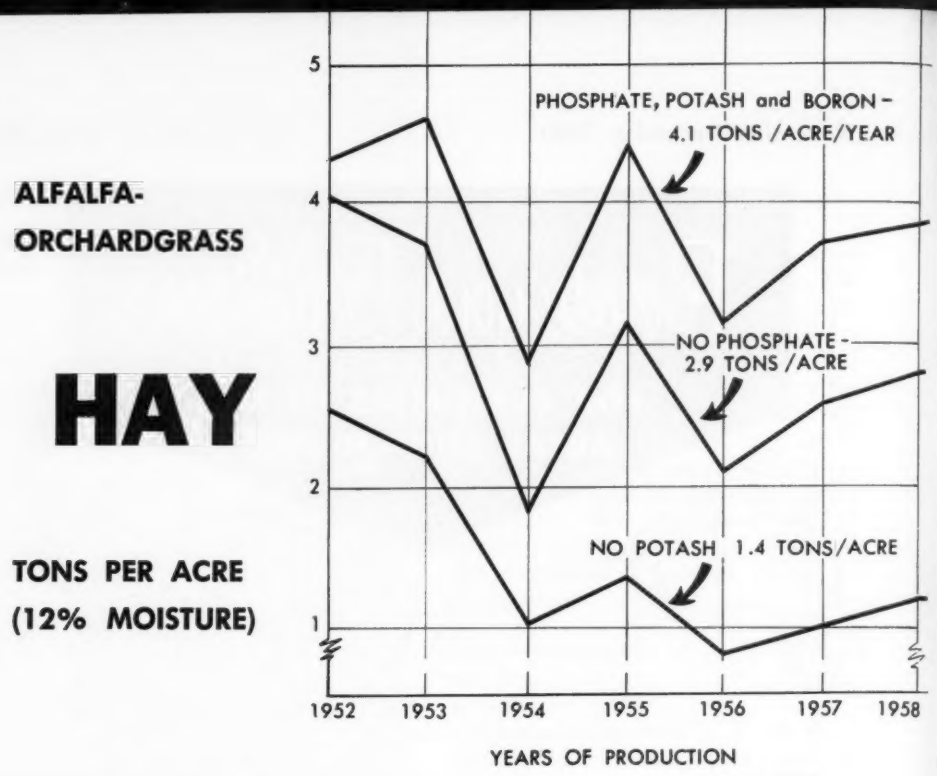


FIGURE 1: START TRANSLATING YOUR YIELDS

FERTILIZING SILAGE AND HAY CROPS

By R. E. Blaser Virginia

TO STAY in business, today's forage farmer must produce high yields to insure sufficient profits over and above the many costs involved in modern-day farming.

These costs include those of establishing, maintaining, and harvesting grass-legume mixtures for silage and hay. They include land, labor, and machinery costs, many of which are fixed production costs per acre whether the yields are high or low.

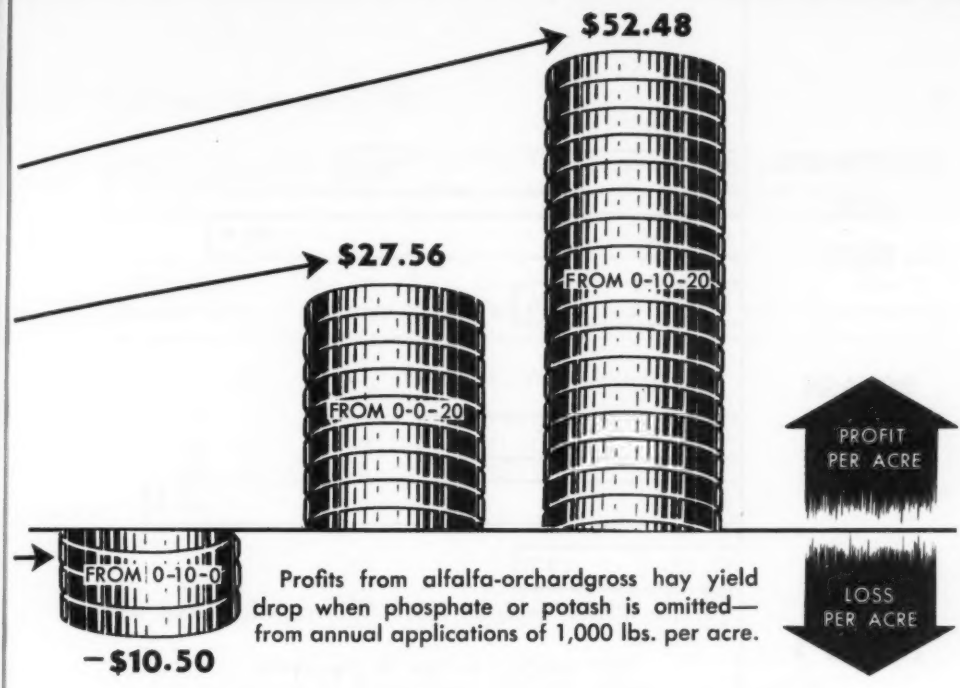
The best way to secure high yields that keep yourself in the profit column is to follow a liberal lime and fertilizer program. This means two important practices: (1) Using lime and fertilizer in the seedbed to establish good stands of grasses and legumes; (2) Applying fertilizers annually to maintain high yields and long-lived stands.

The success of producing high yields and quality of sod crops for silage and hay depends on: (1) planting the best adapted grass-legume mixtures for soils on the farm, (2) adequate lime and fertilization, (3) adapted certified varieties, (4) good establishing techniques including seed inoculation, (5) suitable harvesting practices, and (6) weed and insect control where necessary.

All these principles determine a successful production program. Neglect of any one of these factors means failure.

Fertilizer for Establishing Hay Crops

Soil characteristics such as drainage



Profits from alfalfa-orchardgross hay yield drop when phosphate or potash is omitted—from annual applications of 1,000 lbs. per acre.

. . . INTO PROFITS LIKE THIS

FOR PROFITS

Polytechnic Institute

of individual fields must be considered in selecting grass-legume mixtures.

Deep, well-drained soils are especially suited to alfalfa. Soils with high water tables at certain seasons may be used for the more shallow rooted legumes, such as Ladino clover and red clover.

Use enough lime and fertilizer to stimulate quick establishment of desirable grasses and legumes. Soil tests should be used as a guide for lime and fertilization. The most desirable pH for alfalfa is 6.5 to 7.0 and for other legumes, 6.0 to 6.8.

The amount of fertilizer and its analyses for establishing legume-grass sod crops depend on soil characteristics and fertilizer history of soils. The general recommendations for alfalfa-grass mixtures for Virginia are:

1. **On fertile soils with a medium to high level of potash**—500 to 700 lbs. per acre of borated 0-30-15 fertilizer or the equivalent (150 to 200 lbs. P_2O_5; 75 to 100 lbs. K_2O per acre).
2. **On fertile soils with a medium to high phosphate level and a low level of potash**—800 to 1,000 lbs. of borated 0-14-14 per acre or the equivalent (110 to 140 lbs. P_2O_5; 110 to 140 lbs. K_2O per acre).
3. **On sandy soils or soils which have a low fertility level**—1,000 to 1,200 lbs. of borated 2-12-12 fertilizer or the equivalent per acre, plus enough phosphate to raise the total applied to 200 lbs. P_2O_5 per acre if the need is indicated by a soil test (20 to 25 lbs. N; 120 to 200

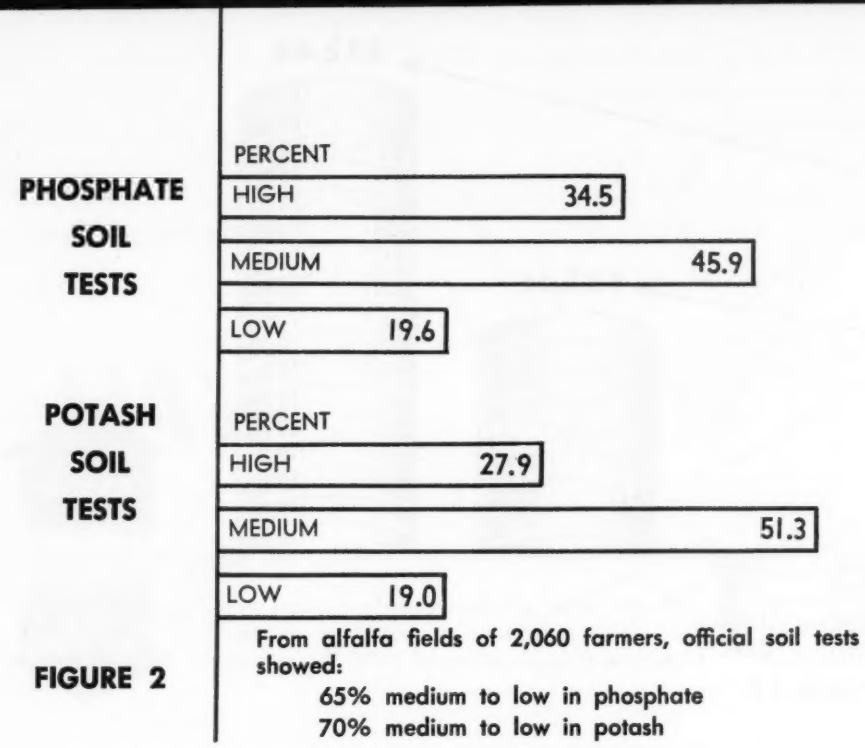


FIGURE 2

From alfalfa fields of 2,060 farmers, official soil tests showed:

65% medium to low in phosphate

70% medium to low in potash

lbs. P_2O_5; 120 to 140 lbs. K_2O per acre).

Phosphate

Liberal phosphate fertilization is justified for establishing new seedings because phosphorus stimulates seedling growth. Such liberal applications of phosphate fertilizer worked into the surface 2 to 4 inches of soil is not lost by leaching. If soils are limed, the phosphorus remains available in later years for crop growth. These recommendations for establishment will carry the crop through the first harvesting year.

Nitrogen

Nitrogen fertilizer should not be used on most soils for establishing grass-legume mixtures. The soluble nitrogen fertilizers reduce the stand of legume seedlings. Alfalfa and birdsfoot trefoil stands were impaired less severely by nitrogen than red and Ladino clovers. Nitrogen fertilizer did not injure the stand as much in 1958 as during the previous two years. There were 24 plants per square foot without nitrogen as compared with 11 when 80 pounds of N per acre was applied during 1956 and 1957.

It is interesting to note that 20 pounds of N per acre reduced the stand of all legumes, but the stand decreased as more nitrogen was applied. The stands of orchardgrass were also injured by nitrogen fertilization.

Nitrogen fertilization did not increase seedling growth during early establishment. The legumes fix their own nitrogen and liberal nitrogen stimulates grasses and reduces legume populations later in the season.

Potash

Liberal applications of potash may also injure seedling stands. But light applications should be used for establishment to avoid deficiencies. It is usually wise to use an 0-2-1 fertilizer for establishment and an 0-1-2 or an 0-1-3 fertilizer for maintenance.

Maintaining Stands and Yields

Farmers often get a good stand of grasses and legumes but fail to use enough fertilizer to maintain alfalfa for good yields. Such cropping plans produce low yields and often die because of stingy or no annual fertilization.

Table 1.—The yields and profit as a result of nitrogen fertilization from an alfalfa-orchardgrass mixture with an excellent and a fair stand of alfalfa.

N applied lbs. per acre	Hay—tons per acre	Gross value	All costs of production and storing hay	Profit per acre (land return)
		Excellent Alfalfa Stand		
0	4.23	$135.36	$ 79.37	$55.99
40	4.10	131.20	83.43	47.77
80	3.96	126.72	87.45	39.27
		Fair Alfalfa Stand		
0	2.00	$ 64.00	$ 68.22	—$ 4.22
100	2.63	84.16	87.90	— 3.74
200	3.20	102.40	102.54	— 0.14

Labor charges at $1.00 per hour and hay valued at $32 per ton.

The fact that farmers do not use enough fertilizer is clearly shown in Figure 2. Soil samples from alfalfa fields were sent in by 2,060 Virginia farmers during a 3-month period this year. The phosphorus soil test shows about one-third of the soils high in phosphorus, with two-thirds of the samples in the medium to low range, Figure 2. The potash soil tests show about a fourth of the fields high in potassium with about three-fourths in the medium to low potash range.

Fields low in phosphorus were not necessarily low in potash. Since this is so, it may be concluded that about a third of the alfalfa fields were actually low in either potash and/or phosphorus. Alfalfa stands at such critically low phosphorus and potash levels are short-lived and very low in production.

Let us look further at the high phosphorus and the high potash soil tests from the alfalfa fields. Here again it was found that soil samples high in phosphorus are not necessarily high in potash. Thus, only about 20% of the fields were high in both phosphorus and potash.

We may say that 1 field in 5 has enough available phosphorus and potash to support high yields and long-lived stands of alfalfa.

Soil samples taken from hay crops other than alfalfa were sent in by 1,622 farmers during this same period. About a third of the samples were low in phosphate and a fifth low in potash. Only about one field out of five was high in both phosphorus or potash.

Stinginess One Reason

Stinginess in fertilization is one of the main reasons for low yields. During the past 10 years, alfalfa yields have averaged 2¼ tons in Virginia. The yields averaged 2½ tons per acre during the last two years.

The yields of recommended varieties in various locations in tests conducted by the Virginia Agricultural Experiment Station averaged 4.1 tons per acre during the last 10 years. Look at the contrast—2.5 tons to 4.1 tons. This points out the need for better fertilization and management on farms.

Figure 3 shows the present yields of legume-grass hay crops obtained by Virginia farmers as compared with

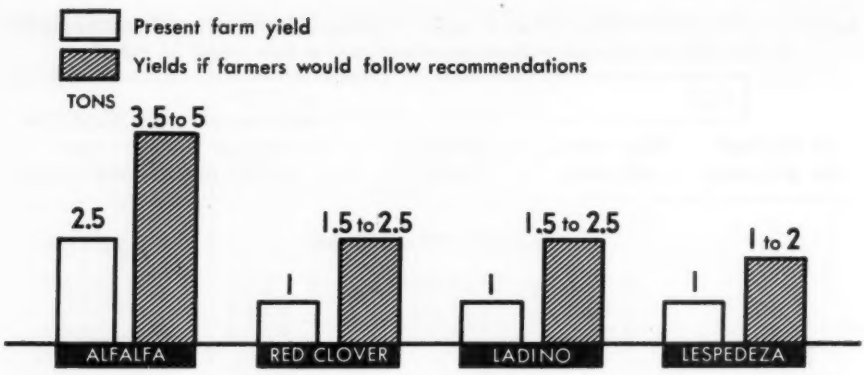


Figure 3—Present and possible hay yields per acre of legume-grass mixtures on Virginia farms.

yields that could be obtained under good management. Many farmers could double their hay yields if they followed recommended practices.

Fertilizer for Maintenance

The need for adequate balanced fertilization is shown by an experiment on a Cecil soil in southern Piedmont, Virginia. Figure 1.

During 7 years, an alfalfa-orchardgrass mixture fertilized annually with phosphorus, potash, and boron (1000 pounds of an 0-10-20) yielded 4.1 tons of hay per acre yearly. When phosphorus was omitted (0-0-20), the yield dropped to 2.9 tons. Without potash fertilizer (0-10-0), the yield dropped to 1.4 tons.

The net profit per acre, Figure 1, was $52.48 when the alfalfa was fertilized with an 0-10-20 fertilizer. When phosphorus was omitted, the profit declined to $27.56 per acre. But without potash, the operation suffered a $10.50 loss per acre.

How Much Potash?

Potash increases profit per acre, but how much potash should be used?

A look at Figure 4 shows that there was a profit of $10.80 per acre when 50 pounds of K_2O was applied as compared with $38.17 per acre when fertilizing with 200 pounds of K_2O each spring. A profit of $40.15 was obtained when 400 lbs. of K_2O was applied. The most profitable practice—securing $49.97 profit per acre—came from applying 200 pounds of K_2O per acre where half of it was applied in spring and half after the first hay cut.

Note how potash helped maintain alfalfa stands in Figure 4. Without potash there was one plant of alfalfa in about every 3 square feet of soil area, compared with more than 3 plants per square foot with high potash fertilization.

The stand of alfalfa and the yield of the alfalfa-grass mixture increased as the potash fertilization increased. Without or with 50 pounds of potash per acre each year, most of the alfalfa plants died during the second productive year. Grasses also responded to potash fertilization.

Nitrogen fertilization is often a good way to increase yields if legume stands are low. The lower the legume stand the greater response from nitrogen, Table 1. Nitrogen fertilizer did not increase the yield of an alfalfa-orchardgrass mixture where there was a 75% stand of alfalfa. It was not profitable to fertilize a good stand of an alfalfa-grass mixture with nitrogen.

In another experiment with a fair stand of alfalfa growing with grass, nitrogen fertilizer increased the yields. However, the yields were low so it was not profitable to fertilize with nitrogen. The high yields from alfalfa

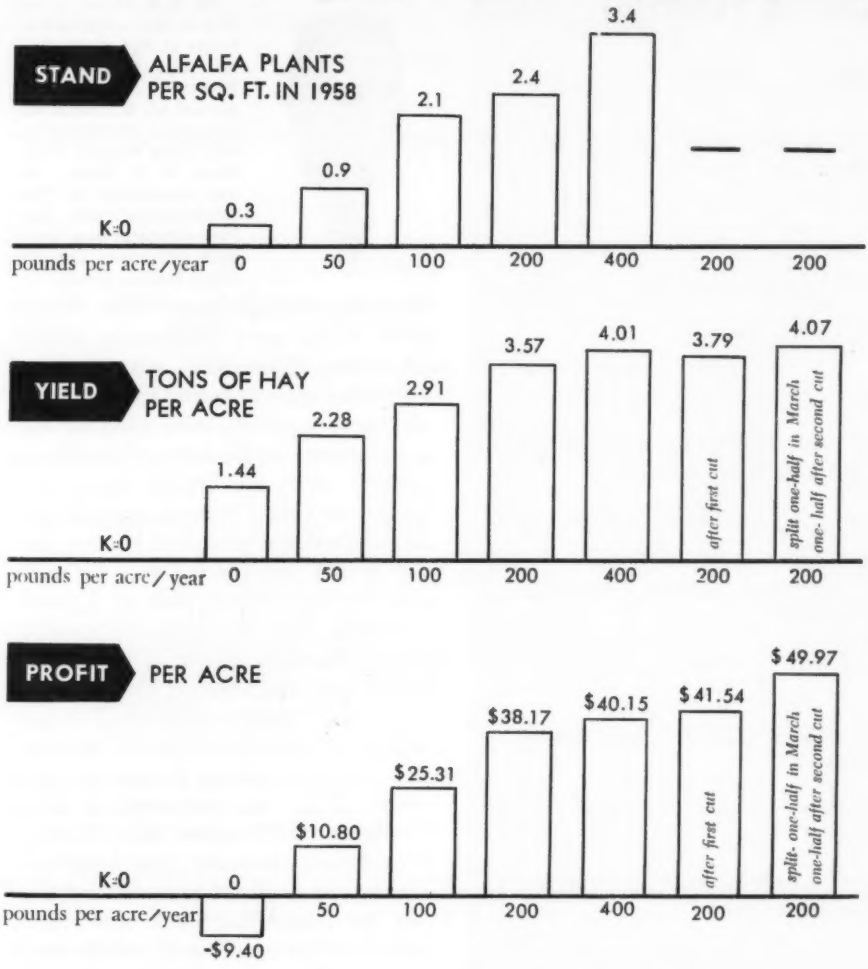


Figure 4—This occurred on cecil soil. * Labor charges at $1.00 per hour and hay valued at $32 per ton. Potash applied in spring unless otherwise indicated.

mixtures are attributed to the drought tolerance of alfalfa. The best thing to do when yields are low is to plow up and start over.

Liberal Fertilization Suggested

We recommend annual fertilization of productive grass-legume mixtures. Productive fields of alfalfa should be fertilized with a minimum of 50 to 100 pounds of P_2O_5 and 100 to 200 pounds of K_2O per acre each year. Six hundred to 1,000 pounds per acre of 0-10-20, 0-9-27, or an 0-14-14 fertilizer will supply these nutrients.

The soil test, soil colloids, response history, and fertilizer applied for establishing mixtures should be considered when choosing the fertilizer. We favor liberal phosphate fertilization for establishing and an 0-1-2 or an 0-1-3 ratio for maintenance.

A 4-ton yield of hay will remove about 200 pounds of K_2O per acre yearly. For this reason, liberal annual K_2O fertilization is recommended.

Using Productive Grass-Legume Mixtures

In this experiment, 2 fields were Ladino clover-orchardgrass mixtures and the other 3 fields were alfalfa-

CHECK YOURSELF

Yes____ No____

Some questions to determine how much this article interested and informed you.

1 Are deep, well-drained soils suited to alfalfa?

yes____; no____

2 Should nitrogen be used on most soils for establishing grass-legume mixtures?

yes____; no____

3 Is liberal phosphate justified for establishing new seedings?

yes____; no____

4 Should potash be used for establishment to avoid deficiences?

yes____; no____

5 Farmers use plenty of fertilizer to maintain alfalfa for good yields?

yes____; no____

6 Soil tests show only 1 field in 5 (in Virginia) with enough available phosphate and potash to support high yields and long-lived alfalfa stands?

yes____; no____

7 Many farmers could double their hay yield if they followed recommended practices?

yes____; no____

8 The need for balanced fertilization is important in forage production—evidenced by $52 profit per acre with it or $10.50 loss per acre without it?

yes____; no____

Dr. R. E. Blaser, a native of Nebraska, is Professor of Agronomy, Pasture and Forage Crops Research at VPI. He earned his B.S. from the University of Nebraska, M.S. from Rutgers, Ph.D. from N. C. State. He has specialized in "the physiological and ecological factors associated with adaptation and utilizing forage plants."

orchardgrass mixtures. The clover-grass fields were rotationally grazed all season. The alfalfa mixtures were harvested early in spring for silage and the three regrowths were used for hay or rotational supplementary grazing as needed. With this flexible use of mixtures more than enough pasture and winter feed was produced to carry one 700-pound yearling per acre throughout the year during each of 6 years.

Alfalfa may be used for grazing where the crop is grazed down in 5 to 10 days and then allowed to grow tall again. Alfalfa yields are low and stands do not last with severe grazing. The yield was about 2 tons per acre when alfalfa was harvested 6 times yearly at 10-12 inches high. Cutting 3 or 4 times annually gave long-lived stands and yields of more than 4 tons hay per acre. The yields were satisfactory when cut 5 times yearly—but, stands with such cutting practices do not last more than 3 to 5 years.

Under good fertilization, we have kept good stands and high yields of alfalfa for 5 to 10 years with 4 annual harvests.

We find it practical to cut alfalfa for silage in spring and then for 3 hay cuts. The silage is cut early in spring when orchardgrass starts to show seed heads. The next three crops for hay are cut in a 1/10 bloom stage. With four cuttings the hay yields are about the same as for 3 full bloom cuttings. However, four cuttings produce about 20% more protein and 10% more feed nutrients than for a crop cut 3 times.

THE END

DEPT. B.C., AMERICAN POTASH INSTITUTE, 1102 16TH STREET WASHINGTON 6, D. C.

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